U.S. Agency for International Development

A Report of the

Office of Energy and Infrastructure

Program Plan
Fiscal Years 1992 and 1993

Bureau for Research and Development
U.S. Agency for International Development
Washington, D.C. 20523-1810

Program Plan
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The Office of Energy and Infrastructure Preview

The Agency for International Development's Office of Energy and Infrastructure plans an increasingly important role in providing approaches to solving the continuing energy crisis in developing countries. Three problems drive the Office's assistance programs: high rates of energy use and economic growth accompanied by a lack of energy, especially power in rural areas; severe financial problems, including a lack of investment capital, especially in the electricity sector; and growing energy related environmental threats, including global climate change, acid rain, and urban air pollution.

To address these problems, the Office of Energy and Infrastructure leverages financial resources of multilateral development banks such as The World Bank and the InterAmerican Development Bank, the private sector, and bilateral donors, to increase energy efficiency and expand energy supplies, enhance the role of private power, and implement novel approaches through research, adoption, and innovation. These approaches include improving power sector investment planning ("least-cost" planning) and encouraging the application of cleaner technologies that use both conventional fossil fuels and renewable energy sources. Promotion of greater private sector participation in the power sector and a wide-ranging training program also help to build the institutional infrastructure necessary to sustain cost-effective, reliable, and environmentally sound energy systems integral to broad-based economic growth.

Much of the Office's strategic focus has anticipated and supports recently enacted congressional legislation directing the Office and A.I.D. to undertake a "Global Warming Initiative" to mitigate the increasing contribution of key developing countries to greenhouse gas emissions. This strategy includes expanding least-cost planning activities to incorporate additional countries and environmental concerns, increasing support for feasibility studies in renewable and cleaner fossil energy technologies which focus on site-specific commercial applications, launching a multilateral global energy efficiency initiative, and improving the training of host country nationals and overseas A.I.D. staff who can help to reduce expected global warming and other environmental problems.

To pursue these activities, the Office of Energy and Infrastructure implements the following six projects: (1) The Energy Policy Development and Conservation Project (EPDAC); (2) The Biomass Energy Systems and Technology Project (BEST); (3) The Renewable Energy Applications and Training Project (REAT); (4) The Private Sector Energy Development Project (PSED); (5) The Energy Training Project (ETP); (6) The Energy Technology Innovation Project (ETIP); and The Energy Effeciency Project (EEP)

The Office of Energy and Infrastructure helps set energy policy direction for the Agency, making its projects available to meet generic needs (such as training), and responds to short-term needs of A.I.D.'s field offices in assisted countries.

Further information regarding the Office of Energy and Infrastructure projects and activities is available in our Program Plan, which can be requested by contacting:

Office of Energy and Infrastructure
Bureau for Research and Development
U.S. Agency for International Development
Room 508, SA-18
Washington, D.C. 20523-1810
Tel: (703) 875-4052

Chapter 1
Program Plan Overview

Introduction

Power shortages in many countries are the result of a "Triple Bind" of environmental degradation, capital shortages, and inadequate institutional capability. Power shortages create hardships in all socioeconomic sectors, and the environmental impact of energy use can exacerbate those hardships. In addressing these problems utilities are finding that "business as usual" energy sector development strategies no longer generate the capital resources necessary to deliver adequate electric power needed for economic growth. A frequent source of this capital shortage is an inability to adapt to new realities on the part of utilities and power authorities. In response, A.I.D.'s Office of Energy and Infrastructure promotes institutional capacity building, better planning, innovations in more efficient and cleaner technology, and innovative finance in A.I.D.-assisted countries. Critical areas in which the Office works include energy efficiency and conservation, private sector involvement in the power sector, renewable energy, clean and innovative energy technology, and energy planning and policy development. Training is also conducted in support of these activities.

Power Shortages in Developing Countries

The process of economic development involves a transition from low levels of energy intensity to higher levels. Such diverse activities as agricultural development, improvements in health services, and industrial expansion are closely tied to changes in the quantity and form of energy consumed. Prospects for growth are closely linked to the provision of adequate and reliable supplies of power and electricity.

Table 1

Costs of Power Shortages in Developing Countries

Country	Sector	Cause	Cost
Chile	Industrial	Unplanned Outage	$0.25-12.00/kWh
Egypt	Industrial	Unplanned Outage	$0.40/kWh
India	Industrial	Load Shedding	$1.5-3 billion
Jamaica	Industrial	Unplanned Outage	$1.25/kWh
Pakistan	Industrial	Load Shedding	$0.46/kWh
Taiwan	Industrial	Unplanned Outage	$1.00/kWh
Tanzania	Commercial Industrial	Unplanned Outage	$0.70-1.40/kWh

The fact that developing countries need more electrical power for sustainable social and economic development than they are able to produce is demonstrated dramatically by the frequent power shortages that occur in over half of A.I.D.-assisted countries. Many countries frequently suffer power shortages of over 10 percent of their generation capability. In Pakistan, power shortages have reached a level of over 25 percent of demand. These shortages have also had a negative impact on economic growth. Load shedding in Pakistan's industrial sector has led to a 1.8 percent decrease in gross domestic product and a 4.2 percent decrease in the country's foreign exchange earnings. In India, the current 10 percent average cut in power supply to the industrial sector, accomplished by load shedding, is estimated to cause an average annual production loss of over $6 billion, equivalent to 12 percent of the country's industrial output. Power shortages in the Philippines in 1990 cost the economy an estimated $1.1 million per day in lost production.

Table 2

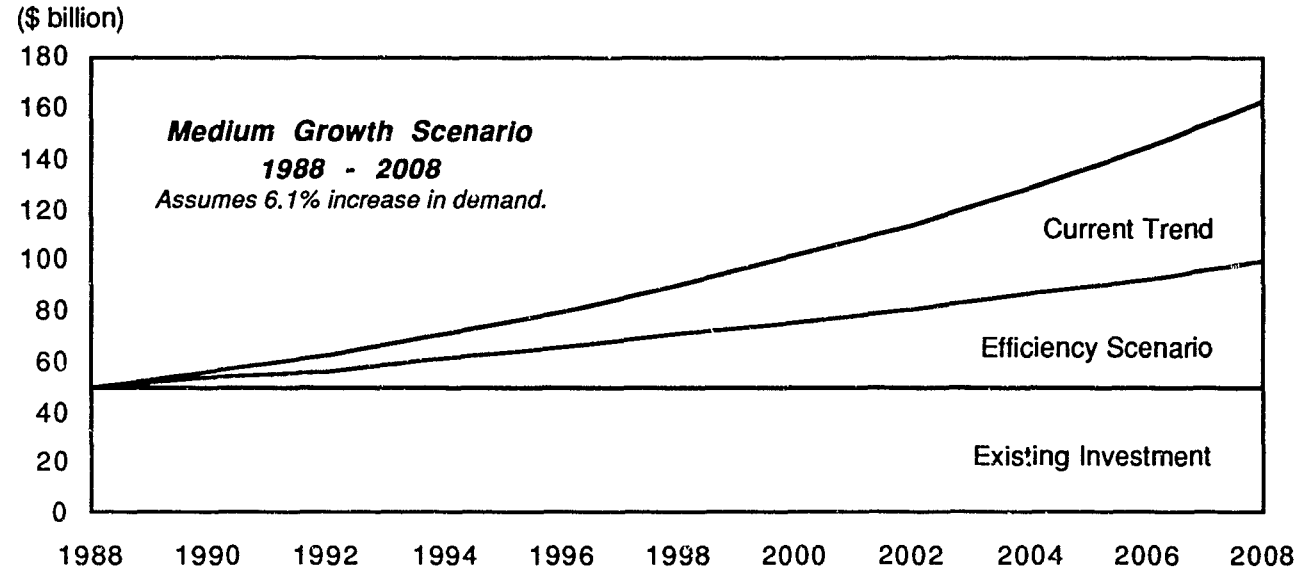
World Energy Use by Region
1985 and Projections for 2030
(EJ/Yr)

Region	1985	Reference	Low Growth	High Growth
United States	77.2	111	96.4	111.2
OECD Europe/Canada	62.9	103	77.1	91.7
OECD Pacific	19.2	39	22.1	24.9
Eastern Europe/USSR	74.9	166	128.5	143.2
Centrally Planned Asia	24.5	88	46.2	87.9
Middle East	7.7	43	28.6	34.4
Africa	8.7	46	12.8	31.6
Latin America	15.7	49	32.4	65.8
South and East Asia	15.1	92	28.6	66.4

In addition, energy use in developing countries is anticipated to grow by a factor of two to four over the next forty years. One of the fastest growing components of the energy sector is electricity. During the past several decades installed generating capacity in developing countries has been growing at a rate greater than 7 percent. In India, installed capacity has been expanding at greater than 9 percent per year. These rates of growth are unsustainable for financial reasons. In many developing countries the largest single area of investment of national funds is the energy sector, with 70 - 85% of those energy investments going into the electric power sub-sector. developing countries invest on average 25 percent of their total development investment budget in electricity infrastructure. Because much of the equipment needs to be imported, and much of the money needs to be borrowed abroad, this represents another significant draw on foreign exchange.

Table 3

Annual Investment Requirements in Power Sector Infrastructure



Environmental Degradation

The exploitation of energy resources can contribute in major ways to environmental degradation. A current concern is the potential for global warming raised by uncontrolled emissions of carbon dioxide into the atmosphere, primarily through the burning of forests in the developing world and of fossil fuels in the industrialized world. In addition, economic growth in developing countries has led to an increase in the use of fossil fuels, thus emulating the energy based pollution habits of the industrialized world.

Table 4

1982-85 Peak Levels of Air Pollutants Concentrations in Selected Third World Cities
(Micrograms per cubic meter)

City	Sulfur Dioxide	Suspended Particulate Matter	City	Sulfur Dioxide	Suspended Particulate Matter
Beijing	625	978	Hong Kong	121	111
Calcutta	188	946	Manila	161	276
Delhi	197	831	Rio de Janeiro	279	229
Guangzhou	206	476	Santiago	188	402

The World Health Organization (WHO) has established air quality standards of 100-150 micrograms per cubic meter for sulfur dioxide, and 150-230 micrograms per cubic meter for suspended particulate matter.

Industrialized nations can contribute to the formation of improved policies, procedures, and technologies in the developing nations to aid them in planning and implementing development strategies that minimize environmental damage.

In the past, leaders of developing nations have often promoted agricultural growth and industrial expansion without regard to environmental costs in order to strengthen their economies. This sense of economic urgency has relegated to low or no priority the reduction of environmental damage inflicted by energy-producing and energy-using activities essential to growth.

Today, however, there are powerful incentives in the energy field to give high priority to actions conducive to environmental protection, even though environmental protection may not be the primary goal.

For example, the economics of energy conservation are persuasive. Energy resources are costly; saving energy saves money. Moreover, conservation of energy is the most cost-effective approach to reducing the adverse environmental impacts of energy production and use. Any steps taken to improve the efficiency with which energy is generated and used conveys the dual benefits of saving money and protecting the environment.

Another incentive is the economically sustainable exchange of environmentally beneficial technology. Clean and innovative energy technologies such as clean coal, cogeneration, and renewable energy (biomass, geothermal, hydropower, solar, and wind) can provide an adequate amount of clean power while transferring new technology to a developing country.

However, increasing concern over environmental degradation is also worsening the capital problem of utilities. Energy activities are the most significant contributors to gas emissions that affect climate change, mostly resulting from the use of fossil fuels. Increased contribution of climate change gases from developing countries will accompany the rapid development of their power sectors. Emissions of SOx and NOx compounds as well as particulates will also increase, thus contributing to acid precipitation and a general decline in air quality, particularly in urban areas.

Adding new equipment in order to address these environmental concerns is expected to cause an increase in the initial capital cost of new power plants, as well as the cost to recondition existing aging power plants. In the U.S., for example, it has been estimated that the cost of additional pollution control equipment required to meet new Clean Air Act regulations will increase the cost of new or reconditioned power plants by approximately US$300 to US$600 per kilowatt of capacity. While it is thought that economic benefits will accrue in other areas, the power sector will have to bear the brunt of this initial capital cost. Developing countries are not now in a position to bear such additional costs without new, more creative, solutions.

Capital Shortages

Developing country utilities, governments, and power developers are finding that "business as usual" energy sector development strategies no longer generate the capital resources necessary to deliver adequate electric power needed for economic growth. A 1988 A.I.D. Report to the U.S. Congress[1] estimates that for the period from 1988 to 2008 developing countries will require an additional 1,500 GW of generating capacity and related transmission and distribution facilities to maintain a moderate economic growth rate. The cost of this added capacity is roughly $2.5 trillion, or an average of $125 billion per year. A number of World Bank and other studies have produced similar estimates. Of this annual requirement, $40 billion is needed in foreign exchange. However, only $7-$10 billion is available from all external sources, including both bilateral and multilateral agencies, as well as private creditors. Thus, the foreign exchange gap is on the order of $30 billion per year, or on the order of $600 billion for the period in question.

Developing and industrial countries also have little capacity to mobilize more than a fraction of the local currency required by these energy expansion plans. Tariffs are often insufficient to cover current operating costs much less system expansion. And with developing country expenditures on the power sector averaging approximately 25 percent of the public budget, investments in other sectors, such as health and education, are limited.

Table 5

Capital Resource Constraints	$ billion per year
Total Capital Requirements	125
Foreign Exchange Required	40
Available Foreign Exchange Resources (Loans, credit, etc.)	7-10
Foreign Exchange Resources Gap	30-33

Developing countries are quite aware that this power related financial crisis will become more severe as debt mounts and new loans become more difficult to secure, and that economic disruption and political instability could ensue. Deteriorating utility performance and the consequent unreliability of delivered power already exact a heavy toll on economic growth. The adverse economic effects of power supply interruptions can be from five to one hundred times the average electricity tariff.

Why has this capital crisis arisen?

Inadequate Institutional Capability

The financial performance of many utilities in developing countries is considerably lower than that of developed countries and has been worsening. Poor planning practices, operations, accounting, billing, and maintenance (stemming in large part from a lack of autonomy) limit the ability of utilities to deliver adequate electricity for development and sustained growth. For example, in the area of transmission and distribution, losses in developing countries typically amount to 20-25% of electricity generated, compared with 7-8% in the U.S. In the developed world losses are due primarily to the laws of physics, while in developing countries they are due to more intractable problems such as undue political influence and theft.

Due to this poor financial performance, government-owned utilities in developing countries often show a negative return on assets. Over the period from 1966 to 1987 the main indicators of financial performance for developing country utilities have declined steadily. The rate of return on assets fell from 9.2% to 4.4%; the operating ratio (ratio of total operating cost, net of capital costs, to operating revenue) rose from 0.68 to 0.81; and the investment self-financing ratio dropped from 24% to 19%. Operating efficiency is also significantly lower than what is possible, thus causing an undue strain on the environment.

Table 6

Financial Performance of Utilities Average Annual Value				
Financial Indicator	1966-1973	1974-1979	1980-1985	1986-1987
Rate of return (%)	9.2	5.8	5.9	4.4
Operating ratio	0.68	0.77	0.80	0.81
Investment self-financing ratio	24	17	18	19

Inadequate tariffs have probably been the single most critical factor in poor financial performance. Studies undertaken by the World Bank indicate that average tariff yields in developing countries should be about US¢10/kWh (1989 prices). Actual tariffs only amount to US¢7/Kwh. However, the spread among individual countries is very wide, ranging from US¢1 to US¢2 in a few countries to more than US¢20 in a number of others. In most countries, tariff levels have generally been well below long-run marginal costs and in quite a number of them even below average operating costs. In these cases, governments provide subsidies to cover parts of the shortfall (at heavy costs to themselves), and operational performance of the utilities suffers from the insufficiency of funds.[2]

Technology Cooperation

The Office of Energy and Infrastructure believes that commercial viability is the key to the adaptation and diffusion of environmentally sound technology in developing countries. Adaptation and subsequent diffusion of technology occurs principally as the result of exports of goods and services, direct foreign investment, joint ventures, and licensing. Technology has been adapted most successfully in those countries where the business environment encourages such adaptation, such as those which offer adequate protection for intellectual property, relative ease in establishing and operating businesses, and in repatriating profits. The successful introduction and adaptation of technologies requires a mutually supportive and non-confrontational process among all parties. We refer to this process as "Technology Cooperation" rather than technology transfer.

Technology cooperation is an on-going iterative process in which two or more parties (countries, private interests, or corporations) identify individual and mutual interests in sharing information, knowledge, know-how, and managerial skills for the utilization of technologies appropriate to local circumstances that will protect the environment, promote increased energy efficiency, use raw materials with greater efficiency, control pollution, encourage recycling, and achieve sound, sustainable development. The overall goals of technology cooperation is to achieve development that is economically, environmentally, and socially sustainable.

Successful technology cooperation requires certain "building blocks" to be in place such as sound economic conditions, national capacity, an assessment of the country's technology situation, a sound decision-making process, and information arrangements.

To promote technology cooperation the Office of Energy and Infrastructure focuses on involving the U.S. and developing countries' private sector in:

- institutional capacity building,
- better planning,
- more efficient and cleaner technology, and
- new and innovative approaches to finance.

Institutional Capacity Building

Institutional capacity building helps public officials, private firms, and individual citizens to understand, diffuse, and apply the functions, operation, and realities of the technologies needed for sustainable development. Institutional capacity building can encompass formal education, training abroad, hands-on and on-site training, and applied research, as well as strategic planning, decision making, government incentive structuring, and technology life cycle operations and maintenance activities at the national level.

In terms of energy institutions, experience in developing countries has shown that adoption of cleaner and more efficient energy technologies does not take place in a utility overly burdened with political influence and with little motivation to increase financial performance. Reform of the energy sector to allow the utility more autonomy is a prerequisite to improved performance. While public ownership does not preclude autonomy, the prevailing view is swinging toward the inclusion of the private sector as perhaps the most effective route to increased autonomy - at least in some of the developing countries.

In Latin America, for example, Argentina, Bolivia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Jamaica, Nicaragua, and Panama are all pursuing appropriate private participation in the power sector. Argentina, Costa Rica, and the Dominican Republic have special laws concerning private power, and Costa Rica and the Dominican Republic have a special regulatory structure in place for private power. In addition, private power projects have been proposed in all of these countries.

Mobilizing private capital for power development is the rationale most often given for increasing private sector involvement. Supporting that rationale is a clear desire to increase the efficiency of the sector and to develop more effective power generation technologies and systems. Autonomy derived from privatization or restructuring allows for rationalizing tariffs, basing them on long run marginal costs. The removal of burdensome bureaucratic procurement and civil service requirements allows utility management to provide the potential for faster introduction, management, and utilization of new and more cost-effective energy technologies.

The private sector has been the source of most technological and system management innovation in the power sector. With its focus on efficient operations and enhancing its rate of return, private sector firms have invested heavily in technological and system management innovation. Private sector innovation has led to the installation of cost effective pollution control technologies, the design of more environmentally benign generation facilities, the adoption of innovative techniques for system management, and led the move toward the use of computer technology for system planning and load forecasting, generation dispatch, and personnel management.

Privatization in developing countries has spawned the adoption of new technologies, ranging from fluidized bed combustion systems for burning low quality fuels in a cleaner fashion, to direct combustion of bagasse and other agricultural residues formerly considered waste. These technologies offset significant quantities of imported oil and markedly reduce air pollution.

A.I.D. has taken a leading role in assisting developing countries privatize their power systems. We usually begin by exploring policy alternatives with developing country leaders and often provide expertise from U.S. utilities or regulatory bodies that have experience in activities they are initiating. Developing country officials visit the United States to see first hand how a large and complicated private power system operates, both in utilities and with independent non-utility power systems. A.I.D. has been instrumental in bringing about major policy revisions in over a dozen countries[3] that now allow private investment in the power sector. In several of those countries (the Philippines, the Dominican Republic, and Costa Rica to name three) private power systems are now operating and supplying needed electricity to the national grid.

Better Planning

Basic assessments of system parameters and dynamics, as well as policy and planning activities, are required to identify problems and recommend corrective measures. In collaboration with the private sector, the Office assists utilities and host governments conduct sector appraisals so they may better evaluate options open to them, as well as enhance the ability of donors to define

innovative development strategies. Using sector appraisals, the Office assists in formulating policy and legislation to promote environmentally sound policy and management projects.

For several years now, the Office has supported informal groups, made up of working level professionals in bilateral and multi-lateral organizations as well as other donors and federal agencies to learn from each other how better to adapt and develop innovative power sector technologies to developing country use. The groups have sponsored joint research programs and provide a forum for international collaboration. In addition, A.I.D. recently signed a Cooperative Agreement with the World Bank to facilitate upfront activities leading to new grants and loans. A.I.D.'s Office of Energy and Infrastructure is A.I.D.'s facilitator of this Cooperative Agreement.

More Efficient and Cleaner Technology

U.S. commercial energy and environmental technologies are among the most clean and efficient technologies in the world. Successful implementation of these technologies in developing countries increases their national capabilities; improves economic, environmental, and social conditions; and creates a knowledgeable market for future U.S. products and services.

To promote the use of these technologies in developing countries the Office of Energy and Infrastructure involves the U.S. private sector, focusing not only on developing innovative technologies, but also on innovative ways of disseminating and financing that technology.

As a step in this direction, the Office is promoting user-supported, market-driven research in critical technology areas through consortia which include electric utilities, manufacturers, universities, and national laboratories to tap the private sector for innovative technology. A hallmark of this approach is that developing countries participate directly in the development and adaptation of innovative technologies, and thus are able to influence the outcome so that innovative technologies are also appropriate to the developing country situation.

Other methods of dissemination of information on clean and innovative technologies include trade missions, reverse trade missions, and study tours which offer developing country decision makers an opportunity to view technologies in action, and U.S. industry to see the need for such technologies first-hand. Seminars, workshops, and conferences offer public and private sector decision makers an opportunity to exchange information. Other communication outreach activities such as information clearinghouses, public access databases, and publications transfer information in a "user friendly" manner.

Innovative Project Structure and Finance

If developing countries are to improve their energy delivery services then projects must be commercially and economically viable. Given increasingly serious constraints on foreign assistance funding, the Office is finding it critical to leverage its funds with private sector trade and investment promotion and multilateral funding. The Office of Energy and Infrastructure works with developing countries, donors, and multilateral development banks to pool their resources to access and influence larger amounts of funds for development activities.

One way for developing countries to achieve the benefits of newly built power stations is through "performance-based" construction and operating arrangements with private companies. Under these arrangements, the private company is responsible for constructing, financing, and often, owning and operating power stations and selling the output to the host country through the national grid. With performance-based contracting, the host country would pay only for services received. The host country utility would then not control the production facility. Rather, it would simply purchase the output of the facility. This approach would differ from the more commonly

practiced approach where the host country utility would purchase and construct the facility, own and operate the station, thereby accepting the total risks associated with electricity production. If accidents or force major events were to cause the plant to be inoperable, the host country utility would continue to be saddled with the responsibility of meeting the plant's debt service.

An important tool for identifying environmentally sound and commercially viable project opportunities is preinvestment studies. Preinvestment studies allow for the development of technical and economic information to prove the commercial viability of a given project, thus enhancing the opportunity for private sector investment. The Office cost-shares with private industry up to 50% of the cost of preinvestment studies for projects which the Office feels may be particularly successful.

Congressional Concerns

The influence of Congressional legislation has also helped shape the Office's approach to technology cooperation. The *Foreign Assistance Act*,[4] which authorizes A.I.D. activities, notes that the purpose of much of the assistance provided to the agricultural, industrial, social service, and other sectors in developing countries by A.I.D. is undermined by the inability of many of these countries to satisfy their energy requirements.

The *Foreign Assistance Appropriations Act of 1990*[5] mandated the A.I.D. Administrator to implement a "Global Warming Initiative" that focuses the Agency's energy assistance on helping to mitigate the increasing contribution of "key" developing countries to greenhouse gas emissions resulting from deforestation and fossil fuel combustion. These key countries, as designated by A.I.D.'s Working Group on the Environment, are Brazil, Indonesia, India, Poland, Pakistan, the Philippines, and Mexico. Also included are Central America and the Congo Basin (which consists of Zaire, Gabon, Congo, Equatorial Guinea, Cameroon, and the Central African Republic). Each region is treated as a country for this purpose.

The Act also directed the Agency to enhance its assistance efforts in "improved energy efficiency, increased use of renewable energy resources and national energy plans (such as least-cost energy plans), which include investment in end-use energy efficiency and renewable energy," as well as to augment its staff with energy and environmental expertise to carry out the Initiative.[6]

To reinforce this mandate, the *Foreign Assistance Appropriations Act of 1991*[7] directs the A.I.D. Administrator to take additional steps to strengthen the Initiative. Another measure is the Act's earmarking of $20 million for the Office of Energy's FY 1991 budget. According to both the House and Senate Appropriations Committee Reports, this increased funding is intended to emphasize the primary or critical role of the Office of Energy in providing expertise for implementing the Agency's Global Warming Initiative. The House Report calls for the application of this expertise to expanded programs in energy efficiency, renewable energy, and least-cost energy planning. The Senate Committee Report calls for increasing the role of renewable energy and energy efficiency in A.I.D.'s overall approach to energy assistance in developing countries.

A 1991 Foreign Assistance Act has yet to become law. However, indications are that Congressional support for past themes will be continued. For example, in the Committee Report of the Foreign Operations, Export Financing, and Related Programs Appropriations Bill for 1992, the House of Representatives stated its support for a number of energy and environmental issues:

- the World Bank's Global Environmental Facility,
- sustainable energy development at the World Bank
- the R&D Office of Energy and Infrastructure,

- A.I.D. energy and environmental staffing
- renewable energy and energy efficiency, including the interagency group Committee on Renewable Energy Commerce and Trade (CORECT),
- A.I.D.'s Global Warming Initiative, and
- rural electrification.

Organization of the Office

To address power shortages and environmental degradation from industrial sources in developing countries the Office of Energy and Infrastructure focuses on alleviating capital shortages and inadequate institutional capability by promoting institutional capacity building, better planning, more efficient and cleaner technology, and innovative finance. The Office has designed seven projects to serve these needs of developing countries, as well as Congressional concerns and A.I.D. initiatives:

- Energy Planning and Policy Development
- Energy Efficiency Project
- Private Sector Energy Development Project
- Renewable Energy Applications and Training
- Biomass Energy Systems and Technology
- Energy Technology Innovation Project
- Energy Training Project

The Energy Planning and Policy Development (EPPD) program addresses institutional capacity building, better planning, and innovative finance through four main project elements. Strategic assessments and policy development activities promote the use of integrated resource planning (sometimes called least-cost planning). Project development support and technology cooperation activities promote cooperative ventures between U.S. industry and developing country organizations to commercialize new technologies in the host country. Environmental impact assessment and mitigation activities develop host country capabilities in that area. Information dissemination, training, and reverse trade missions help build links between U.S. and developing country public and private sectors, thus enhancing the technology commercialization process necessary for the transfer of infrastructural scale technology.

The now-ending Energy Conservation Services Project (ECSP), and the follow-on Energy Efficiency Project (EEP), builds the capacity of a host country to use energy efficiency as a clean energy technology. The program has three main elements. Activities to promote energy conservation as a response to global climate change involves technical assistance to A.I.D. Missions and regional bureaus, as well as developing countries in designing energy efficiency programs. Private sector technology transfer and training activities support the transfer of U.S. energy efficient technologies through trade development activities such as market assessments, study tours, conferences, and workshops. Energy conservation and demand management activities focus in three sectors: power systems, industry, and the building and transportation sectors. Activities in these areas focus on technical assistance to identify problems, develop options, and plan strategies, as well as to develop a standard manual for engaging in such activities.

Private Sector Energy Development (PSED) project activities are designed to build institutional capacity, promote clean energy technology, and stimulate innovative finance. Assistance to define and implement private enterprise involvement focuses on country assessments; conferences, workshops, and study tours; and technical assistance. Resources available to foster private electric power project development include a feasibility study fund and workshops on

project development and privatization. Information is gathered through contact with industry and collected in the Private Power Database. Dissemination of information is accomplished through the quarterly publication, *Private Power Reporter*.

The Renewable Energy Applications and Training (REAT) project catalyzes replicable and sustainable investments in renewable energy technologies that in turn can meet important rural and urban needs for reliable high quality and environmentally sound energy on a significant scale. Program elements include strategic assessments and policy development, project development support, environmental impact assessments and mitigation activities, information dissemination, training, and trade and reverse trade missions.

The Biomass Energy Systems and Technology (BEST) project identifies and reduces the technical, economic, financial, and institutional risks associated with implementing biomass energy systems in A.I.D.-assisted countries. This is accomplished through biomass energy project development and implementation, technology adaptation and transfer, and biomass energy program support.

The Energy Technology Innovation Project (ETIP) focuses on technical assistance for the development and implementation of clean energy and environmental technologies, and on building the institutional capacity to operate and manage such technology. Activities to promote innovative clean energy technology applications focus on technical assessments and trade missions. Activities to promote environment enhancement technology applications focus technical assessments of environmental control technologies and implementation of environmental monitoring systems. Energy efficiency and availability improvement activities provide technical assistance to increase power plant efficiency, thus decreasing the pollution emitted per unit of output. Energy management and operations are strengthened by working directly with host country managers and operators to demonstrate sound techniques.

The Energy Training Project (ETP) builds institutional capacity by conducting training courses in six areas: Energy Policy, Planning Analysis, and Financing; Management of Energy Enterprises; Fossil-Fuel Exploration and Utilization; Electric Utility Operations and Development; Energy Conservation and Efficiency; and Global Warming Initiatives. Academic training is also occasionally available at the Master's degree level for a small number of energy professionals, as are internships with corporations, universities, and U.S. government agencies.

Endnotes

1 U.S. Agency for International Development. *Power Shortages in Developing Countries: Magnitude, Impacts, Solutions, and the Role of the Private Sector,* March 1988, U.S. Agency for International Development, Washington, DC.

2 Schramm, Gunter. *Electric Power in Developing Countries: Status, Problems, Prospects*, in *Annual Review of Energy*, Volume 15, 1990, by Annual Reviews, Inc., pp. 320 - 321.

3 Philippines, Pakistan, India, Thailand, Indonesia, Costa Rica, Dominican Republic, Panama, Guatemala, Columbia, Jamaica, El Salvador.

4 Foreign Assistance Act of 1961, as amended.

5 FY 1990 Foreign Operations, Export Financing, and Related Programs Appropriations Act (Public Law 100-167).

6 *Ibid.*, Section 534 (b)(1)

7 FY Foreign Operations, Export Financing, and Related Programs Appropriations Act (Public Law 101-513).

Chapter 2
Energy Planning & Policy Development

Background

Creative planning and policy development will be required to implement a successful energy and environmental management strategy. Initiatives in the areas of financing, energy price reform, electrical sector management, and advances in technology will all be essential to provide adequate electrical services in an environmentally acceptable manner. Also, new social compacts between governments and power utilities will have to be forged, and new institutional structures may be required. Innovative energy policy planning strategies and tools are needed to facilitate the design, development, and implementation of efficient energy systems that will meet the needs of developing countries with a minimal capital investment and in an environmentally acceptable manner. Such strategies and tools form the "glue" that holds together all the other essential components of a sound approach such as energy efficiency and conservation, renewable and innovative energy technologies, private sector participation, and training.

Strategy

The Office of Energy and Infrastructure develops and implements innovative policy, planning, and management solutions and approaches that foster sustainable development in the power sector. These solutions and approaches are carefully crafted to mobilize private-sector capital, promote least-cost power sector planning, mitigate environmental impacts of power development, and accelerate the adoption of related energy efficiency measures in the supply and end-use sectors of the power sector The predominant emphasis is on investment portfolio design and policy decision-making processes, with special attention given to implementation. This strategy differs from common approaches which conduct analyses in isolation. Key features of this strategy include global warming issues, least-cost planning methodology, attention to energy efficiency, and the incorporation of renewable energy systems into the overall energy planning process.

The main strategy of the Office of Energy and Infrastructure is to build upon country-oriented power sector strategic assessments. These assessments result in the development of policy recommendations and preliminary target projects. Project identification and development and technology commercialization follow from the major assessment studies A complementary activity is the development of strategies to mitigate the environmental impacts associated with power generation technologies. In addition, training and technology dissemination activities supplement the first three.

A strategic factor in the Office's success in this area lies in that its investments are leveraged wherever possible through collaboration with other donors. These cooperative arrangements provide the various Office projects with a mechanism to coordinate activities, avoid duplication of effort, and leverage the limited funds available from all the participants. These cross-cutting partnerships include the Multi-Agency Group on Power Sector Innovation (MAGPI), the Global Energy Efficiency Initiative (GEEI), the Global Environmental Facility (GEF), and the Energy Sector Management Assistance Program (ESMAP).

The Multi-Agency Group on Power Sector Innovation (MAGPI) is an informal organization consisting of representatives of the World Bank, the Inter-American Development Bank, the Asian Development Bank, the African Development Bank, the International Finance Corporation, the United Nations and a number of bilateral organizations. The Office of Energy and Infrastructure works closely with MAGPI to identify and develop bankable projects designed to catalyze innovation in the LDC electric power sector.

The Global Energy Efficiency Initiative (GEEI) Working Group was conceived by A.I.D to coordinate activities with the Department of Energy, the Environmental Protection Agency, and non-governmental organizations. The GEEI Working Group promotes the efficient use of energy through technical assistance, policy development, project finance, and joint commercial research and development.

The Global Environmental Facility (GEF) is a cooperative venture among national governments, the World Bank, the United Nations Environment Programme, and the United Nations Development Programme. The three-year, $1.5 billion pilot program is designed to help developing countries address major environmental problems. With emphasis on reducing and limiting the emission of greenhouse gases, the GEF can be used to augment efforts to implement clean coal technologies and renewable energy systems.

The Energy Sector Management Assistance Program (ESMAP) was launched by the World Bank and UNDP in 1983 to assess a range of innovative energy options that deserve more serious consideration by donors and developing countries. ESMAP was conceived as a preinvestment facility to help implement recommendations made during the course of assessments, and is managed by a steering committee, known as the Consultative Group for Energy Sector Management Assistance, consisting of representatives from the World Bank, U.N.D.P., bilaterals, and other contributors.

Planned Accomplishments

The specific activities of the Office of Energy and Infrastructure provide field support to the Missions or the regional Bureaus. For example, global projects such as the Environmental Manual development project are intended for use in specific mission-oriented programs.

Strategic Assessments and Policy Development

Power sector energy and environmental assessments consist of several components and include as a key issue the investigation of the power planning and investment mobilization process under capital constraints. Additionally, the assessments examine approaches that include system efficiency and demand-side management strategies as cost effective alternatives to supply expansion.

The traditional approach of power planners in the developed and developing nations has been to focus almost exclusively on finding the least-cost generation mix to meet growing power demands. The growing reality of capital constraints, however, requires that the notion of least-cost planning be expanded to allow symmetrical treatment of all supply and demand options, not just power generation.

This will include price reform as well as a rational and explicit set of policies, regulations, and structures to determine the technical requirements for independent power generation, grid interface, and the contractual arrangements for the purchase of electricity and capacity from private power plants. A typical LDC power sector assessment would consist of the following study components:

1. Demand Forecasting and Investment Mobilization
2. Economic Efficiency of Retail Tariffs
3. Power Sector End-Use Energy Efficiency
4. Environmental Impact of Power Development
5. Power Supply, Sector Organization and Institutional Capability
6. Sector Fuel Supply Options
7. Integrating Power Systems Operations

Planned Accomplishments:

1. Conduct a "Long Term Issues in the Power Sector" appraisal with USAID/India, the World Bank, and ODA of Britain.

2. Initiate a Power Sector Energy and Environmental Assessment study in Indonesia.

3. Support the application of microcomputer-based tools for least-cost investment planning under capital constraints.

4. Support an initiative on power investments and the environment with the Asian Development Bank.

5. Complete comprehensive least-cost investment planning project in India.

6. Complete comprehensive least-cost investment planning project in Costa Rica.

7. Undertake a marginal cost study for short and long-term purchase power contracts in Costa Rica.

8. Develop a new rural power lending strategy with the World Bank and the Asian Development Bank.

9. Implement the multidonor agency Electric Utility Performance Improvement Initiative and provide a report with recommendations to LDC governments, donor agencies, and multilateral development banks.

Project Development Support and Technology Cooperation

In addition to the Global Energy Efficiency Initiative and the Global Environment Facility, the Office of Energy and Infrastructure has been working with USAID/India to develop two model projects to address the development and commercialization of new and clean energy technologies. These projects when successful will provide a useful model for other developing countries to follow.

The Program for the Acceleration of Commercial Energy Research (PACER) is a six-year, $20 million India/U.S. collaborative science and technology initiative that began in August 1987. The purpose of PACER is to foster innovation in the Indian electric power sector, in part through

facilitating the establishment of R&D consortia that link the industrial, commercial, R&D, and government sectors. The program selectively addresses innovative approaches to the introduction and diffusion of technologies for energy conservation and efficiency, renewable energy, clean coal technology for power generation, and improved transmission and distribution planning and technologies.

Since its inception, PACER has supported over 26 energy technology development projects and energy research studies in the private sector, and an additional 16 projects under various stages of formulation. EPPD assisted USAID/India in the design of PACER, and the Office of Energy and Infrastructure will expand the PACER model to other rapidly modernizing developing countries.

The Energy Management Consultation and Training (EMCAT) project is a bilateral Indo-U.S. initiative signed into agreement in June 1991. The purpose of EMCAT is to introduce technology, financing, and management innovations in the Indian power supply and demand sectors to permit enhanced capital productivity, improved delivery of energy services and reduced environmental impacts. EMCAT is administered on behalf of the Government of India by two key Indian development finance institutions: the Power Finance Corporation (PFC) for the power supply efficiency component; and the Industrial Development Bank of India (IDBI) for the end-use efficiency component.

Planned Accomplishments:

10. Implement a cooperative grant with the World Bank for energy efficiency and the private sector, and project preparation for the Global Environmental Fund (GEF).

11. Implement a $2[illegible] million power sector efficiency program (EMCAT) with USAID/India, the World Bank, and the Asian Development Bank.

12. Provide networking and management support for the Global Energy Efficiency Initiative.

13. Assess U.S. trade and investment opportunities in energy efficiency markets in India.

14. Implement efficient lighting in residential and commercial buildings in the Philippines.

15. Implement least-cost strategies for efficient lighting in residential and commercial buildings in Mexico.

16. Explore implementation of the PACER concept to Indonesia.

17. Support USAID/India on PACER proposals and on coal conversion technology programs.

18. Initiate an IGCC demonstration project in India.

Environmental Impact Assessment and Mitigation

Making decisions regarding technologies and policies for energy production in developing countries requires careful assessment of environmental impacts in addition to economic impacts. Consequently, knowledge of fuel cycle and power generation technology characteristics, alternatives for achieving development objectives, and the potential of environmental impacts have

become critical to energy sector planning and decision making. The Office of Energy and Infrastructure supports environmental impact assessments and mitigation by:

1. working with international organizations and multilateral development banks for the improvement of international energy and environmental development,

2. working with industry and developing country officials to improve the state of the art for incorporating environmental management objectives into energy facility investment decision making, and

3. creating in developing country officials the environmental capabilities to support siting, construction, operation, maintenance, and decommissioning of energy conversion facilities, as well as development of policies, standards, and regulations, as appropriate.

Planned Accomplishments:

19. Support the Environmental Manual for Power Development - Phase 2: manual development.

20. Collaborate with the World Bank, Asian Development Bank, and the Rockefeller Foundation to support Brazil and the Asian Energy Institute in reducing greenhouse gas emissions in Asia.

Information Dissemination, Training, and Reverse Trade Missions

Human resource development and information dissemination are crucial elements to sustainable power sector development. the Office of Energy and Infrastructure will work with U.S. universities to develop technical degrees in developing country institutions, including vocational training and career development. These activities will be coordinated with the implementation of energy efficiency projects and programs. The Office of Energy and Infrastructure will also foster the development of institutional networks to promote information dissemination throughout developing countries and with the institutions of industrialized nations.

Planned Accomplishments:

21. Develop an end-use efficiency technology menu in India.

22. Conduct GEEI training.

23. Develop an improved cookstove dissemination program through CEMAT (a Guatemalan-based organization focusing on woodstove development).

24. Under the GEEI, provide Secretariat support for the Stockholm Initiative on Energy, Environment, and Sustainable Development.

25. Provide support to Indian/U.S. workshop on the development of a CFC-Free Energy Efficient refrigerator for India.

Chapter 3
Energy Efficiency and Conservation

Background

Increased efficiency in the various stages of energy conversion and distribution is important to continue sustainable economic growth, control external debt, and protection of the environment. The historical truism that increased energy input, or energy supplies, is critical to economic growth sometimes obscures an important insight.

Increased efficiency in the various stages of energy conversion and distribution is important for economic and environmental reasons, as well as energy security, prompted by the increased volatility of oil prices and growing concern over environmental degradation.

Most energy systems impose stresses on the environment that eventually affect humans in a variety of ways, including occasional direct assaults on human health. Greater efficiencies in energy systems, however, can mitigate these stresses. Energy efficiency improvements and conservation can represent cheap, quick, and relatively painless ways for most developing countries to stretch energy supplies, slash energy costs, and save foreign exchange. By producing more output with the same energy cost input, energy efficiency improves the productivity and competitiveness of energy-consuming enterprises.

For example, analyses completed by the Global Energy Efficiency Initiative (GEEI) Working Group, initiated by the Office of Energy and Infrastructure, show that the efficiency of energy conversion in Eastern European countries can be improved by 20 percent in the next 10 years, and even reach 50 percent savings in some areas. Energy conservation by "mass production" has reduced consumption by 5 percent in one-fifth of the industrial sector in Pakistan, and studies of commercial buildings in Thailand have identified a savings potential of 50 percent or more with payback periods of 2.5 years or less.

Growing energy efficiency needs in developing countries also create increased export opportunities for U.S. technologies. Energy conservation technology imports by developing countries totaled $4.2 billion in 1990, of which the U.S. market share was 10 percent, but declining. This market is growing at 2-3 percent annually. Close collaboration between developing countries and U.S. industry can help improve the competitive advantage of American firms and help increase U.S. market share in energy efficiency technology and services.

The proper policy and investment climate is important to the success of energy efficiency and conservation programs. Many energy conservation projects will not succeed if energy users do not receive the correct policy signals. If policy tools were to be ranked in terms of their general effectiveness in promoting energy conservation, correct pricing signals would be at the top of the list. Experience has shown, however, that rational energy pricing is often a necessary, but not sufficient, condition for energy conservation. Substantial impediments remain, such as lack of information, trained manpower, availability of technologies, and adequate and attractive financing. Thus, rational pricing needs to be complemented with other types of assistance, such as training, institution building, technical assistance, information dissemination, and often some form of financial assistance (at least during the early stages of an energy conservation program).

Strategy

A.I.D. places increasing emphasis on the linkage between energy conservation and efficiency, and environmental and health issues. In the near-term, the types of assistance supported by the Office of Energy and Infrastructure can help provide immediate relief from balance of payments burdens, foreign exchange and capital shortages, and other problems brought on by the need to pay for oil with hard currency. The Office's long-term goal is to develop lasting technical and management capabilities in the host countries to identify and implement energy conservation programs and an institutional and policy framework to support and promote energy conservation. Achievement of this goal will ensure that energy conservation continues after technical assistance has ended.

Office of Energy and Infrastructure efforts also create increased trade opportunities for U.S. firms specializing in energy conservation technologies and services. To this end, the Office is working closely with active federal and state agencies such as DOE, DOC, EPA, and TDP, as well as with NGOs to launch a series of initiatives to identify and quantify energy conservation markets and to assist U.S. firms identify and develop specific opportunities.

The Office of Energy and Infrastructure will continue to take both a micro approach and a macro approach to achieve its short and long term energy conservation goals. The micro approach focuses on assisting countries design and implement specific energy conservation and efficiency projects.

The macro approach focuses on comprehensive power sector planning as an essential part of the development of a policy and institutional framework for energy conservation and efficiency. Through the development of balanced investment plans, the costs of alternative approaches to the delivery of energy services are compared, supply-side efficiency improvements and various demand-side options weighed, and environmental costs approximated. Efficiency improvements in turn help to reduce these latter costs.

This approach complements the Office's efforts in the area of energy planning and policy development, which aims to promote least-cost power sector planning and the implementation of energy efficiency measures. Least-cost power sector planning expands the domain of traditional planning to emphasize technical improvements in all elements of the power sector.

Planned Accomplishments

Implementation of the Office's strategy involves specific planned accomplishments in energy conservation and efficiency in five basic categories:

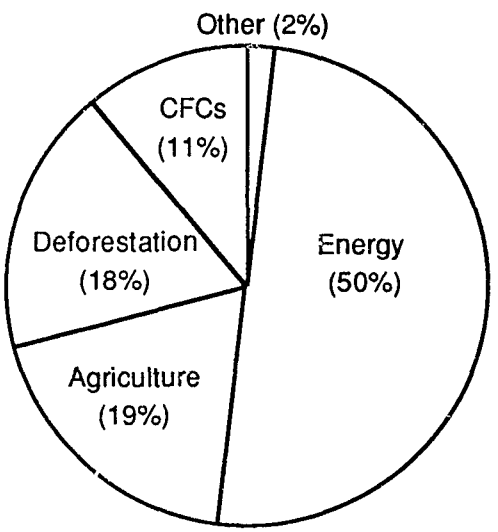
- Promoting energy conservation as a response to global warming
- Promoting private sector technology transfer and training
- Assisting energy conservation and demand management in power systems
- Aiding energy conservation and demand management in industry, and
- Assisting energy conservation and demand management in the building and transportation sectors.

Energy Conservation as a Response to Global Climate Change

Reducing fossil fuel consumption through improved energy efficiency and fuel substitution is the most immediately available and politically acceptable means for coping with the threat of global warming. Energy production and use is responsible for approximately 50 percent of the annual global production of atmospheric carbon dioxide (CO_2). CO_2 levels have increased 25 percent in the last 150 years, reaching a level not experienced in the last 130,000 years. Continued consumption of fossil fuels will increase CO_2 levels further, possibly bringing about a significant warming in the global atmosphere and a rise in sea levels, forcing rapid changes in demographic, biologic and economic patterns.

Table 7

Sources of Greenhouse Gas Emissions



At the direction of Congress, A.I.D. has launched a Global Warming Initiative. Efforts to improve energy efficiency are a key component of this initiative. The Office of Energy and Infrastructure has developed a comprehensive program for accelerating energy conservation and efficiency projects to address global warming, from a global institution-building effort (the Global Energy Efficiency Initiative) to specific activities in key countries, such as Brazil, Indonesia and Mexico.

Planned Accomplishments:

1. Maintain the Global Energy Efficiency Initiative (GEEI), work with industry groups to identify suitable projects for the private sector, and maintain a tracking system and database to monitor energy conservation worldwide.

2. Conduct a mission to Brazil as part of USAID's Global Climate Change Activity to identify potential areas for assistance in energy efficiency and renewables.

3. Design a national energy conservation program for Indonesia, to fulfill the Indonesia presidential decree on energy conservation.

4. Implement energy efficiency project in Mexico, focusing on demand-side management to achieve least-cost utility planning and transportation efficiency.

5. Identify and implement energy efficiency programs in Western and Eastern Africa, focusing on institution building to address energy efficiency and environmental issues, with linkages to the preeminent African-American universities.

6. Conduct a feasibility study of natural gas and LNG to meet the needs of LDCs and assist in carrying out a natural gas utilization study in one country as a means to reduce oil consumption and CO_2 output.

7. Design and implement a worldwide energy conservation outreach and technical information dissemination plan.

8. Design and implement a demand-side management program in Guatemala to achieve least-cost utility planning.

9. Assist the development of an A.I.D. Energy Strategy for the Latin America and Caribbean Bureau of USAID.

Private Sector Technology Transfer and Training

The United States manufactures and exports some of the world's most efficient technologies, and competes with Japan and Europe to sell these technologies in world markets. These technologies include combined cycle power plants, computer-based control systems, heat exchangers, lighting equipment, windows, refrigerators, electric motors, variable speed drives, and refrigeration and air-conditioning equipment. Additionally, energy service companies have been developed that could provide services overseas or could be used to transfer know-how through joint ventures.

The Office of Energy and Infrastructure cooperates with U.S. industry, other U.S. government agencies (e.g., DOE, EPA, TDP), and multilateral development banks to design initiatives to increase the rate of penetration of U.S. energy efficient technologies into developing country markets. The Office is currently working on several tasks in this area:

- identifying promising technologies;

- targeting key countries in which to conduct detailed market assessments;

- forming industry working groups comprised of U.S. manufacturers;

- providing assistance to these private sector groups to identify and develop specific market opportunities; and

- assisting in project preparation at the preinvestment level.

Additionally, these activities have been extended to cover ozone-depleting substances, industrial waste minimization, and power plant emissions, as these sectors require application of the latest technologies and similar analytical approaches.

Planned Accomplishments:

10. Conduct country-specific market assessments and development activities for promising U.S. energy efficient/environmental control technologies (ASEAN and Mexico).

11. Carry out surveys, conferences, workshops, study tours and exhibitions to promote exports of energy-efficient technologies and services by U.S. manufacturers and ESCO's.

12. Conduct energy efficient and environmental control technology transfer project in ASEAN region.

Energy Conservation and Demand Management in Power Systems

Electricity demand increases even faster than overall energy demand in a developing economy. The burden of providing increased generation capacity falls primarily on the public sector in most A.I.D.-assisted countries, thus placing tremendous strain on government budgets. On average, each of these countries spends 20-40 percent of its annual government budget on the electricity sector. In addition, a majority of the necessary generation technology needs to be imported, thus exacerbating foreign exchange shortages.

Many A.I.D.-assisted countries must improve the use of current and new capacity by reducing system losses and increasing end-use efficiency. In many of these countries, the availability factor of power plants is below 50 percent, compared to over 85 percent in the industrialized countries. Transmission and distribution losses consume over 20 percent of total electricity generation in many of these countries, compared to 8 percent in the U.S. Clearly, there is room for significant improvement.

To increase the efficiency of the electricity sector in A.I.D.-assisted countries, the Office of Energy and Infrastructure uses three approaches:

1. Increasing the efficiency of power generation, transmission, and distribution.

2. Improving management of the power load.

3. Enhancing end-use efficiency.

Specifically, the Office prepares generic analytical and practical tools useful to a broad range of countries, offers country-specific planning and technical assistance and training courses, and engages in country-specific studies of efficiency improvement opportunities.

Planned Accomplishments:

13. Provide assistance for the implementation of the Central America Power Efficiency Initiative, which will include power plant rehabilitation, line loss reduction, load management, and end-use efficiency improvements (Costa Rica, Guatemala).

14. Develop a Demand-Side Management handbook for developing countries and conduct a DSM conference to disseminate results worldwide.

15. Carry out preliminary electricity tariff studies designed to develop energy- efficient electricity pricing in cooperation with local utilities (India, Thailand).

17. Implement a load management and demand-side management program in Latin America or the Near East.

Energy Conservation and Demand Management in Industry

Industry has been an important energy conservation and demand management target because this sector typically accounts for 20 to 35 percent of total commercial energy consumption in A.I.D.-assisted countries. Additionally, this sector is responsible for a large portion of the pollution that poses serious long-term threats to human health and sustainable economic development in these countries. Technically-proven, cost-effective energy conservation techniques and processes can save developing countries an estimated 10 to 30 percent of industrial sector energy consumption. This reduction in consumption also contributes to the mitigation of severe pollution problems in A.I.D.-assisted countries by lowering industrial pollutant emissions levels.

Increasing private-sector activity in energy conservation is an important objective of the Office of Energy and Infrastructure's industrial conservation assistance. Achievement of this objective is facilitated by the trend toward privatization in the industrial sector in many A.I.D.-assisted countries. Privatization gives enterprises a clear motivation for cost-cutting through investments in energy conservation. Among private industrial plants, export-oriented firms that must be competitive in world markets are especially receptive to opportunities for reducing energy costs.

The Office will improve the policy and investment climate for private-sector activities, and enhance private-sector capabilities to design, finance, and implement energy conservation projects. The Office will also continue to emphasize strengthening the linkage between energy conservation and industrial pollution abatement, promoting private sector investment in conservation, and building local institutional capabilities to implement energy conservation programs on a long-term basis.

Planned Accomplishments:

18. Conduct study of current status and future directions in cogeneration, including three case studies of private investment in cogeneration.

19. Implement an electricity demand management program in Indonesia.

Energy Conservation and Demand Management in the Building and Transportation Sectors

Much of the growth in demand for electricity in the large cities of developing countries, such as Cairo, Bombay, Karachi, and Bangkok, is driven by the demand for air conditioning and lighting in large commercial buildings. The buildings sector is the fastest growing consumer of electricity in developing countries, with demand increasing by up to 20 percent per year. In most of these cities, there is a shortage of available electricity and of investment capital for additional capacity.

The most serious obstacles to improved energy efficiency in the buildings sector are the lack of data on energy use in buildings, lack of awareness of the need and potential for energy conservation in buildings, lack of knowledge about energy-efficient building design, and lack of building codes and standards that ensure energy efficiency The objective of this program is to address the first obstacle --the lack of basic energy use data. By developing a better understanding of energy use patterns in urban buildings, the needs and opportunities for conservation can be

address the first obstacle --the lack of basic energy use data. By developing a better understanding of energy use patterns in urban buildings, the needs and opportunities for conservation can be better identified and pursued.

Energy consumption for transportation represents over 40 percent of total oil consumption in most developing countries. Even small improvements in efficiency can produce large savings on oil import bills and free up resources for more productive uses. Conservation in this sector has received a lot of attention in the industrialized countries, and with significant results, but the subject has received little attention from developing countries.

Scant information exists on the effectiveness of various approaches to conservation in the transportation sector of developing countries. With a small budget, this program must concentrate on low-cost/high-payback measures.

Planned Accomplishments:

20. Update study of options for energy conservation in the transportation sectors of A.I.D.-assisted countries and identify countries for implementation of pilot projects and disseminate worldwide to developing countries and donor agencies.

21. Conduct a building energy standards conference for the ASEAN region and develop a model building energy code for the region.

Chapter 4
Renewable Energy for Development

Rationale

Increased use of renewable energy technologies (those using solar, wind, geothermal, and biomass resources) is important for both economic and environmental reasons. These technologies are technically proven, commercially available, and in growing use in numerous applications throughout the world. They provide energy at significantly less environmental impact than power generated from fossil fuels, and many are economically competitive with conventional power supply technologies in applications ranging from central-station generation (distributed through large grids) to decentralized and stand-alone systems. U.S. industry and utilities have considerable experience that is useful to developing countries.

Technical advances are continually increasing the economic competitiveness of renewable energy technologies in comparison to fossil fuel power plants and power line extension. Because they utilize indigenous natural resources, they supply power independent of world market conditions for fuels and thereby provide a significant measure of energy independence for countries, communities, and individuals. Their modularity also permits incremental investments in power supply to respond to growth in local demand, thereby maximizing scarce capital resources.

In rural areas, relatively small quantities of reliable electricity, thermal energy, and mechanical power can transform the quality of life by providing energy for water pumping and purification, irrigation, lighting, communication, refrigeration, and small-scale industry. Renewable energy systems can supply many of the power and energy needs of rural populations at lower economic cost and environmental impact than either grid extension or diesel power.

Renewable resources also can be exploited to replace or augment site-specific use of fossil fuels for water heating and for air-conditioning in urban areas.

Renewable energy technologies are significantly less harmful to the environment than conventional fossil-fueled systems. The potential of global climate change resulting from CO_2 emissions from fossil fuel combustion is reduced by the use of renewable energy resources. On a global scale, a dramatic increase in the penetration of renewable technologies in the energy sector will require many decades. Therefore, the strategic contribution of renewable energy for stabilization of atmospheric CO_2 concentrations will occur over the long term. However, the impact on local and regional air quality, through avoidance of SO_2, NO_x, hydrocarbon, and particulate emissions, will be immediate in those areas where conditions allow for greater penetration of renewables.

Despite the inherent advantages of renewables, their potential to significantly contribute to world power supply is constrained for a variety of reasons. Although the fuels in most cases are "free" (solar, wind, and agricultural residues, for example), and the levelized costs over the lifetime of the equipment can be lower than competing technologies, the relatively high initial capital cost of the equipment can be a major impediment. Other factors in developing countries are a lack of locally available financing for individuals, communities, and small enterprises to purchase stand-alone systems, and poorly developed local infrastructures for sales, installation, and repair.

In addition, the lack of true marginal-cost pricing for electricity and the absence of suitable long-term avoided cost contracts for grid-connected private power projects has prevented the development of utility-scale renewable energy power systems in most countries. Added to these factors is a low level of understanding and knowledge of the potential of renewables on the part of government energy officials, international and local financing institutions, and bilateral aid agencies. By suppressing the market, these conditions thus restrain investment in large, economy-of-scale manufacturing facilities.

Strategy

The expansion and acceleration of renewable energy technology use on a large scale depends on a multifaceted approach. As part of its strategy, and because particular opportunities related to the use of agricultural residues were perceived by A.I.D. in the 1980s, the Office of Energy and Infrastructure established two projects to promote economic uses of renewable energy: The Renewable Energy Applications and Training (REAT) project and the Biomass Energy Systems and Technology (BEST) project. The former has a mandate to work with all renewable energy resources and technologies, but for self-evident reasons covers solar, wind, small hydro, and geothermal, while leaving the biomass activities to the latter project. The work of both projects is conducted in collaboration with the private sector and policy activities of the Office, with the U.S. renewable energy industry, and with the international development assistance community.

Strategy: Renewable Energy Applications and Training (REAT)

The goal of the REAT project is to catalyze replicable and sustainable investments in renewable energy technologies that in turn can meet important rural and urban needs for reliable, high-quality, and environmentally sound energy on a significant scale. The goal is addressed by the following project elements:

- Strategic Assessment and Policy Development
- Project Development and Technology Commercialization Support
- Information Dissemination, Training, and Reverse Trade Missions
- Environmental Impact Assessment and Mitigation

Strategic Assessments and Policy Development

One facet of this effort will be to incorporate renewable energy into major power sector assessments to be conducted in key A.I.D.- assisted countries. These assessments will involve A.I.D. missions and regional bureaus, the international development banks, host country institutions, and U.S. industry. Integrated resource planning (sometimes called least-cost planning) methods will be used to consider the economic and environmental advantages of renewables within the framework of national power sector development and rural electrification. Rather than academic exercises, these assessments will identify specific targets for renewable energy power generation in national energy plans, and identify the policy requirements and develop strategies for meeting these targets.

The Office is also developing a new international strategy for rural power delivery that will make available substantial rural electrification loan funds for decentralized renewable energy power projects where they are the most economic option. The inherent environmental superiority of renewables and the ability to expand renewable power systems in a modular fashion will be

incorporated into the lending decision criteria. This work is conducted in cooperation with the multilateral development banks, leading bilaterals, and other international financing institutions.

Project Development Support and Technology Cooperation

One of the key goals of the Office is to identify renewable energy projects that have significant potential for commercial success and to leverage the financing necessary for their development. The strategy is to assure that project developers, investors, and others have the information they need to make decisions, to assist at the preinvestment stage in order to reduce perceived risk, and to help transfer relevant technology and skills. The Office does not fund the actual purchase of hardware, but rather plays a catalytic role in commercial transactions.

The Office recently has been working with the U.S. NGO community, U.S. industry, other federal agencies, and the foundation community to establish a small number of funds that can engage in various preinvestment preparation activities that can help make the case for commercial and site-specific applications of renewable energy technologies. The two principal funds are the International Fund for Renewable Energy and Efficiency (IFREE), set up by the U.S. Export Council for Renewable Energy (US/ECRE, a consortium of trade associations), and the Renewable Energy Project Support Offices (REPSO) located in key countries (this is a joint activity between the REAT and BEST projects) and administered by local professionals.

Other commercialization activities include a creative market-seeding concept to demonstrate the potential market for a solar electric powered high efficiency lamp, and support for the Environmental Enterprises Assistance Fund (EEAF), a non-profit venture capital fund (loans and equity) for renewable energy and environmentally sound technologies, which hopes to build a $20 million portfolio within the next five years.

Information Dissemination, Training, and Reverse Trade Missions

Decision makers in developing countries need up-to-date, reliable cost and performance data on renewable energy products, services, and proven field applications. The Office is working with the U.S. renewable energy industry to provide this information through a combination of publications and media productions aimed explicitly at the role of renewables in development, greatly expanded dissemination of available information, and increased dialogue through reverse trade missions and joint A.I.D./industry missions to host countries.

The Office has recently been supporting a major new effort at providing information to remote locations in developing countries -- a low-orbit satellite program called VITASAT, organized by Volunteers in Assistance to America (VITA). The program potentially can be a clearinghouse for questions and answers from the field in a wide variety of sectors; Office support concentrates on renewable energy activities.

Developing country institutions, both public and private, need the skills to develop renewable energy programs and to implement projects. These skills are developed through collaborative work with U.S. industry and developing country professionals in targeted training programs and workshops. These events are coordinated with the federal interagency Committee on Renewable Energy Commerce and Trade (CORECT) and carried out directly by the Office, by US/ECRE and the American Wind Energy Association, and with other CORECT members such as the Department of Commerce, the Export-Import Bank, the Overseas Private Investment Corporation, and the U.S. Trade and Development Program.

Environmental Impact Assessment and Mitigation

In keeping with A.I.D.'s Congressional mandate to play a major role in promoting environmentally sustainable development and to address global climate change, the Office is making a special effort to highlight the environmental benefits of renewable energy. Through the Multi-Agency Group on Power Innovation (MAGPI), the Office will play a major role in the development of an environmental manual for electric power development which will include a renewable energy component. The Office is also supporting several preinvestment efforts for projects which have significant potential for funding by the World Bank Global Environmental Facility.

Planned Accomplishments of the REAT Project

The Office plans to implement a number of activities in the four strategic areas mentioned in the preceding section.

Strategic Assessment and Policy Development

During FY 1992 the Office will support and participate in strategic assessment of the power sectors in key A.I.D countries. The Office will work with host-country governments, U.S. institutions, the international donor community, and others in the development of policies and institutional mechanisms that place renewable energy within the context of least-cost energy development.

Planned Accomplishments:

1. Support and participate in strategic energy sector assessments in key A.I.D. countries in order to define specific targets for renewable energy use and the policies and mechanisms required.

2. Jointly with UNIDO, sponsor an international conference to define the policy and programs that in turn would establish the market potential that will catalyze large-scale production of photovoltaics at reduced costs (India).

3. Work with other U.S. agencies, the U.S. private sector, and the MAGPI institutions to incorporate renewable energy options in MDB rural electrification and power sector lending (Indonesia, Mexico).

Project Development Support and Technology Cooperation

During FY 91 several projects were identified for assistance. These include a joint venture for manufacturing photovoltaic modules in India, PV/diesel hybrid systems and small wind/electric systems in Indonesia, grid-connected wind farms in Costa Rica, and small PV systems in the Dominican Republic. Activities in FY 92 will be a continuation of these efforts and screening of additional projects, with emphasis on A.I.D. key countries.

IFREE and at least two REPSOs (see above) will become operational in FY 92, and the Office expects that excellent opportunities for commercial projects will be identified and supported. The Office will continue to support the Environmental Enterprises Assistance Fund with core funding while that fund uses a $2.4 million loan from A.I.D.'s Bureau for Private Enterprise to make its actual investments.

Planned Accomplishments:

4. Support, in collaboration with the U.S. Rockefeller Foundation, a U.S./Indian joint venture market seeding and financing program for photovoltaic (PV) power applications in rural areas as the basis for leveraging financing for a large-scale private sector PV module production facility in India.

5. Support expansion of a successful private sector PV-based rural residential power delivery project in the Dominican Republic, and foster replication in other countries.

6. Collaborate with U.S. wind energy industry, host country utility, and suitable international financing institutions in conducting preinvestment and prefeasibility analysis supporting project development for a windfarm in Costa Rica.

7. Assist US/ECRE in establishing IFREE and provide support for at least five pre-investment studies.

8. As a joint REAT/BEST activity, provide funds for Renewable Energy Project Support Offices in at least two countries, supporting at least seven pre-investment studies (Costa Rica and Indonesia).

9. Provide continued core funding for the Environmental Enterprises Assistance Fund, leading to at least three additional commercial investments.

Information Dissemination, Training, and Reverse Trade Missions

In FY 92 the Office will continue to provide developing country institutions, the U.S. Congress, the A.I.D. field Missions, and other organizations with information on the status of renewable energy technologies and appropriate applications for a variety of development needs. This information dissemination will be through Office-sponsored publications, The Office will also support training and reverse trade missions directly and through US/ECRE.

Planned Accomplishments:

10. Provide support for the VITASAT program, including the establishment and operation of selected ground stations, in order to exchange information with remote locations.

11. Prepare two videos, and printed materials as requested or appropriate, that provide technical and economic information to LDCs, as well as to USAID Missions.

12. Support participation of LDC nationals in U.S. industry- and government- sponsored training programs and workshops, reverse trade missions, and industry symposia, and field A.I.D./U.S. renewable energy industry teams to explore joint venture opportunities.

Environmental Impact Assessment and Mitigation

As described above, the Office has been working multilaterally on an Environmental Manual for Power Development, through both the REAT project and the EPPD project (see Chapter II, page 14).

Planned Accomplishment:

13. Develop the unit on renewable energy in the Environmental Manual for Power Development, Phase II.

Strategy: Biomass Energy Systems and Technology (BEST)

The Office of Energy and Infrastructure created the Biomass Energy Systems and Technology (BEST) project to identify and reduce the technical, economic, financial, and institutional risks associated with implementing modern biomass energy systems in developing countries. The project has three main components:

- Biomass Energy Project Development and Implementation
- Technology Adaptation and Transfer
- Biomass Energy Program Support

Biomass Energy Project Development and Implementation

The major emphasis of the biomass energy program, as with the broader renewable energy program described above, is to support site-specific projects in partnership with U.S. and developing country private sector companies. To help commercially viable projects secure financing, the Office assists project developers with the preparation of preinvestment studies and business plans.

During 1992 four of the "key" countries identified by A.I.D. for its Global Climate Change Initiative (Brazil, Central America, Indonesia, and the Philippines) will receive attention in an array of activities designed to reduce project risk, attract financial investment, and determine the agronomic and environmental impacts of various biomass energy options. These activities include:

- Industry sector assessments that evaluate the costs and options for representative mills and processing plants to produce excess power for the grid from their processing wastes
- Analyses of off-season fuel possibilities for on-grid systems
- Pricing studies for country-specific cogeneration
- Commercial biomass fuel surveys
- Cost-shared prefeasibility and feasibility studies at specific sites

Recently the BEST project has been cooperating with the REAT project to create a new mechanism to pursue these activities in at least two of A.I.D's key countries -- the Renewable Energy Project Support Offices (see page 28).

Country work has increased somewhat its efforts in the wood, palm oil, and other processing industries, in addition to the sugar cane and rice focus of the past. The Office will continue to evaluate the costs and benefits of baling cane field trash for use as an off-season boiler fuel, and will expand the program to other countries.

Technology Adaptation and Transfer

The Office lends its efforts to the introduction of innovative technology and demonstration of the commercial viability of biomass energy systems. Through a set of working laboratories, the Office mobilizes technical talent from the public and private sectors to delineate the agronomic and environmental impacts of biomass energy systems and determine the requisites for site specific success with new fuels and technology. Much of this technology adoption and transfer is conducted within developing countries themselves so that the relevant institutional memory remains where most needed. In the past, these efforts have included agronomic impacts of cane field trash removal, new technology for cane separation to permit higher value use of sugar and fiber in bagasse, and technical and economic issues associated with biomass field residue baling and use as off season fuel.

The Office also prepares a series of publications, including the Bioenergy Systems Reports, that publicizes program results, educates the financial community on investment options in the field of biomass energy, and attempts to broaden the base from which innovation can be expected.

Biomass Energy Program Support

The Office strengthens worldwide efforts in biomass energy development with three additional types of activities:

- entrepreneurial networking;
- data management and dissemination; and
- communications.

This year, the Office has elected to collaborate with the Biomass Users Network (BUN), a private developing country organization dedicated to biomass energy development and natural resource management. BUN will administer small grants from the Office for the preparation of case studies that detail commercially successful biomass energy projects in developing countries.

Planned Accomplishments: Biomass Energy Systems and Technology (BEST)

The following activities are being carried out in an expanding set of countries, and include the establishment of extensive feasibility support programs in Indonesia and Costa Rica, and investigation of gas turbine technology application and distributed renewable energy electric generation for utilities in Brazil. These new thrusts, together with existing programs in Central America in the sugarcane and wood industries and pending project feasibility assessments in the Dominican Republic, India, and the Philippines, will highlight biomass energy options for reducing the global climate impacts of fossil fuel use.

As a companion set of activities to the working laboratories, the Office promotes the transfer and additional adaptation of these technologies through a series of publications that are distributed widely.

Biomass Energy Project Development and Implementation

The emphasis of the program is to directly catalyze the development of on-the-ground commercial biomass projects in A.I.D.-assisted countries.
Planned Accomplishments:

1. In two key countries, establish and/or maintain Renewable Energy Project Support Offices, and cost-share three or four preinvestment studies for biomass projects (Costa Rica and Indonesia).

2. Conduct an assessment of prospective electric cogeneration at sugar mills, establishing a framework for independent power generation nationwide, in two key countries (with co-funding from at least one USAID Mission) (India and Honduras).

3. Cost-share at least one case study of conversion of wood wastes to electricity (Honduras).

4. Identify two to four additional biomass power development opportunities in key countries for implementation in this or the next fiscal year (e.g., Philippines).

Technology Adaptation and Transfer

Working Laboratories and Bioenergy Systems Reports provide technical and economic information for the implementation of state of the art biomass energy technology in A.I.D.-assisted countries.
Planned Accomplishments:

5. Co-fund the adaptation of advanced conversion technologies, focusing on systems for biomass gasification, and the harvesting and handling of sugar cane field trash.

6. Publish two Bioenergy System Reports (one on wood energy in the context of sustainable forest management context, and a second on intensive silvaculture energy plantations) and proceedings from 1991 conference on energy from sugar cane.

7. Conduct an international conference on the role of biomass energy in rural development and forest resource management.

8. Effect a transfer of expertise in electric distribution system implications of decentralized renewable electric generation between the Pacific Gas and Electric Company and the regional power company serving northeastern Brazil.

Biomass Energy Program Support

The Office is supporting the implementation of biomass energy systems through a number of activities with, and in support of, other groups.

Planned Accomplishments:

9. Assist with the selection and case studies developed in conjunction with the Biomass Users Network.

10. Expand private sector biomass energy opportunities through entrepreneurial networking and promote U.S. private sector opportunities/involvement through exchanges of information.

11. Maintain databases; complete refinement of CANEPRO, a computerized analytical tool developed by Winrock for evaluating sugar mill cogeneration investments.

Chapter 5
Private Sector Participation in the Electric Power Sector

Background

Electric power projects in developing countries have traditionally been structured under the direct supervision of governments, and financed by budgetary resources or sovereign borrowing. However in recent years severe budgetary crises, the reduced sovereign borrowing capacity of many developing countries, the increasingly rapid shift towards privatization, and the need to compete effectively in the global marketplace have forced governments to reassess traditional electric power development strategies.

As documented in A.I.D.'s Report to Congress entitled *Power Shortages in Developing Countries: Magnitudes, Impacts, Solutions, and the Role of the Private Sector*, the lack of sufficient power has become a growing obstacle to obtaining sustained economic growth. A key element in A.I.D.'s ultimate goal of a world in which economic growth and development are self-sustaining is to improve the electric power sector of developing countries.

Electric power development is a highly capital-intensive activity, and the lack of public investment funds in developing countries, combined with the general inefficiencies of government-owned or controlled utilities have created electric power deficiencies in the developing world. Recently, serious financial and operating problems of government owned or controlled utilities have become evident, such as unrealistic pricing, over-staffing and nepotism, cost overruns, political interference, and inadequate operation and maintenance practices. These, together with the debt problems of many developing countries, make financing their rapidly growing power needs over the next decade virtually impossible.

Therefore, A.I.D. and many developing countries are looking to the private sector for help in energy sector development. New strategies which reallocate the risks, responsibilities, and rewards of electric power projects are emerging and challenging public and private constituents to create viable and sustainable projects. These strategies often use the private sector to expand power generation and distribution capacities, and require meticulous planning to restructure existing facilities, build new ones, operate them with market discipline, and in many cases, eventually transfer ownership to a designated party.

Strategy

Although common conditions prevail throughout developing countries, the specific environment for private electric power development is unique in each country. It is logical, then, that a country assessment be conducted to determine the legal, regulatory, economic, financial, institutional, and technical conditions that will have an impact on private enterprise involvement in the electric power sector. In addition, identifying the degree of commitment of the government to allow private sector involvement, and the dynamics of the political landscape are necessary in order to formulate successful implementation plans. Such assessments are conducted in partnership with

the A.I.D. Mission and relevant regional bureau so as not to duplicate or hinder existing or planned efforts.

The Office also provides teams of experts with hands-on experience in private electric power to provide technical assistance to developing countries, A.I.D. Missions and regional bureaus, multilateral agencies, and other pertinent institutions. To insure that the technical assistance sought will resolve the issues at hand the Office analyzes the request, defines the issues, identifies the technical requirements, selects the most qualified available personnel, and organizes and dispatches the technical assistance team.

Study tours to the U.S. focus on enhancing the skills of developing country officials on the strategies and techniques of private sector energy development while establishing a dialogue with U.S. executives and other specialists who can play a very significant role in implementing viable private enterprise projects and activities. An important alternative and/or complement to study tours in the U.S. is the exposure of developing country officials to experiences in other developing countries with similar characteristics and which have overcome similar circumstances.

Training and internships are conducted to promote greater understanding of private sector energy development. Programs entail an interdisciplinary effort encompassing policy, institutional, legal, financial, economic, and technical instruments. The Office has identified and developed three critical points which will serve as central training modules:

- Private Sector Electric Power Policy and Institutional Issues.
- Strategies and Techniques for Project Finance.
- Project Packaging: Creating, Attracting, and Developing Private Investment Opportunities.

In industrialized countries, there is a great need to develop a greater understanding and awareness of these important trends in developing countries. Firms in the U.S. and other industrialized nations must be made aware of the commercial opportunities that global private sector energy development holds for them.

In fulfillment of this aspect of the strategy, the Office conducts seminars and disseminates information on business opportunities to U.S. suppliers, contractors, operators, investors, and financiers through a variety of channels. The Office also organizes and conducts workshops designed to address the practical aspects of electric power project development and privatization in developing countries. These workshops are aimed at assisting U.S. firms seeking to become involved in developing country electric power ventures. Some of the issues covered in these forums are policy and institutional issues, deal structuring, financial architecture, security packages, risk identification and allocation, and other pertinent topics.

Another major feature of the strategy is the reduction of risk through co-financing of preinvestment studies to lower barriers to what would otherwise be an attractive investment option. The Office's Private Sector Energy Development Feasibility Study Fund complements the work of the Capital Projects Office of A.I.D.'s Private Enterprise Bureau, as well as that of official bilateral and multilateral institutions and private organizations. The Feasibility Study Fund shares with private sector companies the cost of pre-feasibility and feasibility studies and other development activities for qualified electric power projects. The existence and availability of the fund is promoted throughout the electric power community to identify and foster qualified project development efforts. Project funding is based on the technical and commercial merits of the proposed project and its probability for implementation.

The Office also gathers information through its Private Power Database which contains information on private electric power activities in developing countries. In addition, this resource includes information on project opportunities, pertinent laws and regulations for selected countries, and listings of U.S. vendors of power and cogeneration technologies.

The quarterly newsletter, *Private Power Reporter*, is instrumental in keeping the public-at-large, and the electric power community in particular, informed on the status of privatization and private sector involvement in the developing countries. The PPR has a circulation of over 4000, approximately 40% of which are mailed to developing country governments and private sector subscribers.

Finally, the Office of Energy and Infrastructure coordinates its activities with A.I.D. Missions and regional bureaus, and other U.S. government agencies such as OPIC, Exim Bank, Departments of Energy and Commerce, Trade and Development Program, and others. In addition, the Office works closely with other bilateral donors, multilateral development banks, and the private sector.

Planned Accomplishments

In order to meet the program objectives, the following specific initiatives and planned accomplishments will be undertaken.

Assist in Defining and Implementing Private Enterprise Involvement

The Office of Energy and Infrastructure lends assistance to governments, utilities, and A.I.D. Missions and bureaus in defining and implementing private enterprise involvement in the electric power sector through country assessments, workshops, conferences, technical assistance, study tours, and training.

Planned Accomplishments:

1. Conduct country assessments to determine the particular legal, regulatory, economic, financial, institutional, technical and political conditions that will impact on private enterprise involvement in the electric power sector (Guatemala, Brazil, India, and republics of the Commonwealth of Independent States).

2. Organize and conduct conferences or workshops on private electric power in Asia, the Middle East, Africa, and Latin America and the Caribbean (India, Thailand, Philippines, Egypt, Kenya, Venezuela, Nicaragua, Honduras).

3. Provide technical assistance to facilitate the development of private electric power (Indonesia, Mongolia, the Philippines, Guatemala, Dominican Republic, Jamaica, and republics of the Commonwealth of Independent States).

4. Conduct study tours in the U.S. and third countries for energy and finance officials from countries in Latin America/Caribbean, Asia, Africa the Middle East, and republics of the Commonwealth of Independent States.

5. Develop and conduct, in cooperation with the Energy Training Program, a training and internship program for senior and mid-level management from developing countries in Latin America/Caribbean, Asia, Africa and the Middle East, and republics of the Commonwealth of Independent States.

Provide Resources to Foster Private Electric Power Project Development Efforts

Part of the Office of Energy and Infrastructure's assistance to developing country governments and utilities is the identification of projects and activities suitable for private enterprise involvement. Once these opportunities are recognized, they must be defined and structured in a manner were the developing country's interests are protected but the project remains attractive to the private sector from a perspective of implementation, operation and profitability.

Planned Accomplishments:

6. Promote and administer the PSED Feasibility Study Fund to attract qualified applicants with a high degree of probability for project implementation.

7. Organize and conduct workshops directed to electric power developers, investors, and financiers on practical aspects of project development and privatization in developing countries.

Information Gathering and Dissemination

The Office maintains the Private Power Database to include information on private electric power activities in developing countries, project opportunities, pertinent laws and regulations for selected countries, and listings of U.S. vendors of power and cogeneration technologies. This information is disseminated through the quarterly newsletter, *Private Power Reporter.*

Planned Accomplishments:

8. Keep the Private Power Database up-to-date on the latest issues and activities related to private electric power.

9. Develop a monthly information package informing A.I.D. Missions and Bureaus of the private electric power activities of the Office.

10. Edit and publish the Private Power Reporter, as well as expand its circulation.

11. Develop a "Bulletin Board" feature for the PPR where project developers, investors, financiers, suppliers and other key players may identify each others needs and capabilities, and foment the formation of projects and project groups.

Chapter 6
Energy Technology Innovation

Background

Addressing both power shortages and environmental degradation in developing countries will depend on increasing energy supplies through innovative technology while reducing energy demand through efficiency improvements and conservation. Development of indigenous energy resources offers a cost-effective way to mitigate the adverse economic growth consequences of imported energy dependence. This includes development of energy resources that, until recent technical innovations, had been considered too low grade for cost-effective development.

For existing energy conversion facilities, such as power plants, petroleum refineries, and natural gas processing plants, the Office's Energy Technology Innovation Project (ETIP) primarily addresses the retrofit of environmental controls to existing facilities. For developing countries, this is a new technology requirement whose magnitude has yet to be established. Major concerns in environmental control retrofit projects are technology costs, maintenance (or expansion) of an energy facility's energy production capacity, efficiency, availability, and avoidance of converting one environmental problem into another (such as converting an atmospheric emissions problem into a solid waste problem).

Environmentally acceptable disposal of both energy and non-energy related solid waste is also a rapidly growing international problem. Innovative technologies have been and are being developed to render the solid waste resulting from power plant environmental controls environmentally benign, or convert captured emissions into useable byproducts. Also, there is increasing recognition that waste-to-energy options, especially electricity generated from municipal and agricultural wastes, can be a cost effective and environmentally sound disposal approach.

Strategy

Cost-effective, environmentally benign mitigation of the gap between energy supply and demand requires innovations in clean energy technology applications, environment enhancement technology applications, energy efficiency and availability improvement, and energy management and operations improvement.

The 1980s have seen the emergence of a number of more cost-effective, clean, and innovative energy production, conversion, transmission, and distribution technologies. Industrialized countries are implementing these innovative clean energy technologies to both sustain economic growth and enhance the environment. These new technologies, either directly or with modifications to suit local conditions, can be equally beneficial for developing countries. In addition to being cost-effective and environmentally sound, innovative clean energy technologies offer many developing countries opportunities to use previously undeveloped indigenous fossil fuel and renewable energy resources and to expand current fossil fuel utilization without environmental degradation.

To effectively transfer innovative clean energy technologies to A.I.D.-assisted countries, the Office performs country assessments on the economic potential for energy technologies, hosts workshops and seminars on selected technologies, and plans and manages trade and reverse trade missions.

Another critical issue facing all countries is the reversal of past environmental degradation and rapid implementation of environment enhancing technologies across all economic activities. Energy production and utilization, as well as solid waste management (both energy and non-energy related solid waste management), are major economic activities that have been internationally identified as requiring immediate, concerted attention.

Successful mitigation of pollution from existing power plants and solid waste requires emissions and cost information. Current emission levels estimates are usually extrapolated from industrialized country data which are not suitable for formulating, implementing, and enforcing cost-effective atmospheric emissions reduction control programs. To conduct such programs, developing countries need to install, operate, and analyze results from more effective environmental monitoring systems. The Office is designing and implementing a multilateral initiative to provide developing countries with the data and financing required to implement national-scope monitoring systems.

Energy efficiency and availability improvement is a third area in need of attention. Projections of surging growth in energy demand in most developing countries is the consequence of surging population growth and the desire for better living conditions. A major limitation on sustaining and expanding developing countries' energy utilization is capital availability. An effective method for maximizing capital use in energy projects is to improve the performance of, and/or expand, existing energy facilities. In many developing countries energy facility performance is poor and poorly quantified compared with industrialized countries. This difference indicates a substantial potential for economically producing and delivering energy by improving existing facilities.

The Office's energy efficiency and availability improvement programs develop and perform activities that involve energy facility rehabilitation, cogeneration, advanced power cycle retrofiting, efficiency improvement through state of the art instrumentation and control applications, plant component diagnostics technology applications, and improvements in fuel quality.

Energy management and operations improvement is also frequently lacking. The availability of sufficient and adequately trained energy management and operating personnel as well as adequate management tools are frequently additional impediments. The lack of experienced personnel, particularly at management levels, is also likely to be a constraint on the rate at which many developing countries can implement environmental assessment and monitoring programs.

The Office of Energy and Infrastructure strengthens management and operations capabilities by working directly with energy and environmental personnel to demonstrate sound management techniques. Technical assistance is offered in specifying and procuring computers and information systems software, demonstrating complex information management applications, and transferring management information systems and analytical techniques developed in industrialized countries to developing countries.

Planned Accomplishments

The overall Office approach is to promote public sector innovation in project planning, development, and financing; apply modern management practices to improve efficiency and financial performance; apply U.S. energy and environmental technologies; develop indigenous

fuels to minimize energy imports; and partner with other international funding agencies and U.S. industry. Specific activities include conducting technical assessment and feasibility studies, providing technical assistance, catalyzing technology transfer and private investment in energy projects, and providing guidance on institutional and policy development.

Innovative Clean Energy Technology Applications

Many innovative clean energy technologies have been developed primarily, or appear best suited, for use in new energy facilities such as power plants, industrial heat plants, central heat and cooling plants, and transport sector liquid fuel plants. These technologies are also attractive for both the repowering/expansion of existing power plants and the replacement/expansion of existing energy transmission and distribution facilities.

Planned Accomplishments:

1. Conduct ASEAN Clean Coal Technology trade mission (jointly with PSED)
2. Clean Coal Technology (CCT) prefeasibility assessment in ASEAN
3. Technical support to India IGCC demonstration (jointly with PSED)
4. Conduct oil shale electricity workshop; initiate Egypt, Israel, and U.S. cooperative project
5. Organize and participate in AFSA infrastructure trade symposium (jointly with PSED)

Environment Enhancement Technology Applications

To successfully address these issues of mitigating pollution from existing power plants as well as solid waste, developing countries require emissions and cost information. Developing countries need to install, operate, and analyze results from environmental monitoring systems comparable to those used in industrialized countries.

To address the need for comprehensive, accurate emissions information, a multilateral initiative will be designed and implemented to provide developing countries with the data and financing required to implement national-scope monitoring systems. To address the need for emissions cost information, projects that quantify both the emissions reductions achievable and associated costs for application of clean coal technology and increased natural gas utilization will be undertaken in specific A.I.D. key global warming countries. Clean coal technology and natural gas are the main supply side options available to most countries for reducing emissions from electricity generation that contribute to global warming and acid rain. Where local resources are adequate, geothermal technology will also be considered.

Planned Accomplishments:

6. Conduct natural gas utilization definitional mission and workshop in key global warming country
7. Plan and implement an atmospheric emissions monitoring systems initiative and associated multilateral financing fund. Assess technology options for global warming emissions reductions (key countries).
8. Assess the costs and benefits of solid waste-to-energy applications (Thailand)

9. Develop (with BEST project) rice hulls power plant project (Egypt)

10. Environmental opportunities definitional mission

11. Geothermal opportunities assessment

Energy Efficiency and Availability Improvement

The Office develops and performs projects that involve energy facility rehabilitation, cogeneration, advanced power cycle retrofiting, efficiency improvement through state of the art instrumentation and control applications, plant component diagnostics technology applications, and improvements in fuel quality.

Planned Accomplishments:

12. Conduct Phase 1 of power plant availability improvement project in Philippines (jointly with PSED).

13. Power plant diagnostics project development in India.

Energy Management and Operations Improvement

The Office strives to strengthen management and operations capabilities by working directly with energy and environmental personnel to demonstrate sound management techniques. To accomplish this, Office technical assistance includes specifying and procuring computers and information systems software, demonstrating complex information management applications, and transferring management information systems and analytical techniques developed in industrialized countries to developing countries.

Planned Accomplishments:

14. Scope energy resources management information system in Philippines (buy-in project).

15. Capital infrastructure program support project for the Philippines; manage and perform.

16. Perform a power plant operation and management needs assessment in an Asian country to be determined in collaboration with the U.S.-Asia Environmental Partnership (AEP).

Chapter 7
Energy Training

Background

True development in the countries assisted by the Agency for International Development requires that they gain skills and build institutions that will make the development process sustainable and predominantly indigenous. A critical component of that process is the ongoing acquisition and effective utilization of energy resources.

Techniques and technologies for enhancing energy efficiency have reached high levels of sophistication in the industrialized world. On the supply side, they include assessment methods and technologies for mining, harvesting, and converting energy resources in ways that accommodate environmental concerns. On the demand side, they include end-use analysis, operations auditing, systematic maintenance, and efficiency-conscious management.

These tools must be made readily available to policy-makers and managers who face the complex tasks of setting priorities for the allocation and utilization of energy resources. In setting priorities, decision-makers must take into account the most pressing social and economic needs of their nations, the political system within which they must work, the extent and capabilities of their human resources, the availability of non-energy resources required to carry out energy operations, the amount of capital available for various lines of action, and the varying environmental impacts of alternative energy technologies.

The United States has much to offer developing countries in assisting them to make these decisions. A substantial knowledge base has been developed by U.S. engineers, planners, economists, and managers. Path finding results of research and development on such man-created phenomena as global warming and climate change - and the new technologies deriving from them - can be readily transferred to the developing world through technical training.

Technology transfers are increasingly facilitated by recognition among the developing and newly democratizing nations of the world of the benefits of free-market economics and the institutions and policies that support them. In many of these nations, "privatization" is a word no longer to be abhorred, but rather to be adopted as the key to economic progress. For example, some nations are taking first steps toward the transfer of electric utilities and other energy enterprises from public to private hands. In many cases, U.S. consultative services, technical training, and modern equipment are ensuring the success of these ventures as private enterprises.

Strategy

In terms of enhancing energy efficiency, minimizing environmental damage, and supporting privatization, a systematic Human Resource Development strategy is needed that combines technical skills in the energy sector with skills in environmental management. The most pressing need in developing nations is for technically skilled personnel in all phases of energy exploration, exploitation, production, operations, maintenance, distribution, and management.

Recognizing the need as long ago as 1980, the Office of Energy and Infrastructure began a systematic, diversified program of training as an efficient and cost-effective way of transferring human-resource and technical skills to cooperating countries. Since then, the program has steadily expanded and improved, in response to Congressional directives and to specific training needs identified by cooperating nations and by program alumni, their employers, and professional evaluators.

Elements of the overall program include formal training for practicing professionals in energy management, engineering, production, utilization, policy and planning, conservation, environmental protection, privatization, and related topics.

Complementing the major components of all other Office of Energy and Infrastructure programs, these courses are offered by U.S. training cooperators selected for their demonstrated competence. They include electric utilities, academic institutions, government agencies, national laboratories, proprietary training organizations, oil refineries, exploration companies, and other private-sector engineering and consulting firms.

An important subsidiary benefit of these training programs is the establishment of close working relationships between the developing-nation professionals thus trained and their training institutions. These ties have often led to business opportunities for the American organizations providing the training, as alumni successfully advocated the purchase of their trainer's equipment or services upon returning to their home countries.

The Office designs energy-related training programs to meet the specific needs of governmental, parastatal, and private employers in developing nations. Conducted either in the United States or abroad, most of the training is short-term--typically from two to seven months. A small percentage of the trainees pursue Master of Science programs at American universities.

Whether short- or long-term, the training is intensive, demanding, practical, and full-time. To the maximum extent, it emphasizes the "hands on" approach in actual work settings. Participants in these courses are required to return home immediately following graduation, in order to put their newly gained knowledge and skills to work in service to the energy needs of their nations.

To increase the likelihood that newly acquired skills will actually be put to use, the Office requires each employer who nominates a candidate for training to provide round trip international air transportation, pay full salary while the participant is in training, and guarantee employment upon return.

The expectation is that the new skills will be incorporated into long-term institutional capability. In the best of worlds, alumni transfer their skills to colleagues, who then apply them throughout their respective organizations.

This training strategy addresses adverse environmental impacts of energy and industrial activities and some of the proven policies, procedures, and technologies which help to minimize them.

Planned Accomplishments

The framework for energy training courses planned as training accomplishments is organized into the categories identified below, each of which is explained in full in the text which follows.

- Energy Policy, Planning, Analysis, and Financing
- Management of Energy Enterprises
- Fossil-Fuel Utilization
- Electric-Utility Operations and Development
- Energy Conservation and Efficiency
- Global Warming Initiatives

Energy Policy, Planning, Analysis, and Financing

Scheduled Course

National Energy Policy and Planning (6 months), for mid- to senior-level energy managers and planners with five to fifteen years of professional experience. Prepares participants to solve national and institutional energy planning problems in efficient and cost-effective ways, analyze various energy systems, anticipate future energy needs, and identify and evaluate options for developing and using national resources to meet national and institutional needs.

Management of Energy Enterprises

Scheduled Course

General Management of Electric Utilities (13 weeks), for mid- to senior-level technical managers from utilities and other companies which produce or utilize energy as a primary commodity. Designed to enhance and refine managerial and decision-making capabilities, improve energy planning capacity in rapidly changing environments, assist in the development of comprehensive and responsive action plans, and enhance program implementation and monitoring.

Fossil Fuel Utilization

Scheduled Course

Low Rank Coal Utilization (8 weeks), for senior managers and decision-makers from Eastern Europe. The course will train them to evaluate state-of-the-art clean-coal technologies and operational methods for improving cost, efficiency, and environmental control. It is designed to assist the transition from central planning to market-based decision-making. Upon completion of the course, participants will be able to assess various options with respect to technical, environmental, and economic feasibility. Five to seven participants each will be chosen from Bulgaria, Czechoslovakia, Hungary, and Poland.

Electric Utility Operations and Development

Scheduled Course

Electric-Utility Engineering (12 weeks), for electric- utility engineers with experience in power generation. Covers all aspects of power-plant and substation maintenance, operation, power generation (including diesel generators and turbines driven by steam, gas combustion, and hydropower), environmental-pollution control, and cogeneration.

Global Warming Initiatives

Scheduled Courses

Ambient Air Pollution Monitoring (13 weeks), for regulatory and company technical personnel. Practical internship on ambient air pollution modeling, monitoring, measurement, analysis, and reporting. Course examines regulatory environment and required infrastructure.

Air Pollution Control Technologies (7 weeks), for plant managers and senior operations personnel. Comprehensive, practical training on mitigating environmental impacts of fossil-fuel burning for industrial purposes and electric-power generation at the plant level. Course will include sizing, specification, procurement, and installation of pollution-control equipment and its operation and maintenance.

Other Programs

Academic Training. The Office provides academic training at the Master's-degree level for a small number of energy professionals in positions requiring broad-based theoretical as well as technical knowledge of their fields. During FY 1992, seven Pakistani participants funded by USAID/Islamabad are expected to complete requirements for their MS degrees.

Internships. At Mission request, the Office arranges working internships for energy professionals--generally in highly specialized fields--with corporations, universities, governmental agencies, consulting firms, and other enterprises with the requisite expertise.

Philippines BOT/BOO. The Philippine BOT (Build-Operate-Transfer) Project consists of two phases, under sponsorship of USAID/Manila and in cooperation with the GOP Coordinating Council of the Philippine Assistance Program, as follows:

- An initial, three-day privatization Forum for senior GOP officials (at the level of Secretary and Undersecretary) and senior executives from the private sector, covering such key topics as privatization efforts in other nations, benefits/costs of such efforts, Philippine BOT/BOO legislation, risk allocation, and financial issues, to promote cognizance and to facilitative decision-making; and

- A four-week training program for mid-level GOP officials and private-sector professionals, providing a privatization overview and framework, working knowledge of how to proceed with BOT projects under consideration by the employer of each participant, and a simulation exercise presenting a BOT negotiation/transaction in a realistic, competitive setting.

Appendix 1
Office of Energy and Infrastructure
FY 1992 Planned Accomplishments

Energy Policy and Planning Development

Strategic Assessments and Policy Development

1. Conduct a "Long Term Issues in the Power Sector" appraisal with USAID/India, the World Bank, and ODA of Britain.

2. Initiate a Power Sector Energy and Environmental Assessment study in Indonesia.

3. Support the application of microcomputer-based tools for least-cost investment planning under capital constraints.

4. Support an initiative on power investments and the environment with the Asian Development Bank.

5. Complete comprehensive least-cost investment planning project in India.

6. Complete comprehensive least-cost investment planning project in Costa Rica.

7. Undertake a marginal cost study for short and long-term purchase power contracts in Costa Rica.

8. Develop a new rural power lending strategy with the World Bank and the Asian Development Bank.

9. Implement the multidonor agency Electric Utility Performance Improvement Initiative and provide a report with recommendations to LDC governments, donor agencies, and multilateral development banks.

Project Development Support and Technology Cooperation

10. Implement a cooperative grant with the World Bank for energy efficiency and the private sector, and project preparation for the Global Environmental Fund (GEF).

11. Implement a $20 million power sector efficiency program (EMCAT) with USAID/India, the World Bank, and the Asian Development Bank.

12. Provide networking and management support for the Global Energy Efficiency Initiative.

13. Assess U.S. trade and investment opportunities in energy efficiency markets in India.

14. Implement efficient lighting in residential and commercial buildings in the Philippines.

15. Implement least-cost strategies for efficient lighting in residential and commercial buildings in Mexico.

16. Explore implementation of the PACER concept to Indonesia.

17. Support USAID/India on PACER proposals and on coal conversion technology programs.

18. Initiate an IGCC demonstration project in India.

Environmental Impact Assessment and Mitigation

19. Support the Environmental Manual for Power Development - Phase 2: manual development.

20. Collaborate with the World Bank, Asian Development Bank, and the Rockefeller Foundation to support Brazil and the Asian Energy Institute in reducing greenhouse gas emissions in Asia.

Information Dissemination, Training, and Reverse Trade Missions

21. Develop an end-use efficiency technology menu in India.

22. Conduct GEEI training.

23. Develop an improved cookstove dissemination program through CEMAT (a Guatemalan-based organization focusing on woodstove development).

24. Under the GEEI, provide Secretariat support for the Stockholm Initiative on Energy, Environment, and Sustainable Development.

25. Provide support to Indian/U.S. workshop on the development of a CFC-Free Energy Efficient refrigerator for India.

Energy Efficiency and Conservation

Energy Conservation as a Response to Global Climate Change

1. Maintain the Global Energy Efficiency Initiative (GEEI), work with industry groups to identify suitable projects for the private sector, and maintain a tracking system and database to monitor energy conservation worldwide.

2. Conduct a mission to Brazil as part of USAID's Global Climate Change Activity to identify potential areas for assistance in energy efficiency and renewables.

3. Design a national energy conservation program for Indonesia, to fulfill the Indonesia presidential decree on energy conservation.

4. Implement energy efficiency project in Mexico, focusing on demand-side management to achieve least-cost utility planning and transportation efficiency.

5. Identify and implement energy efficiency programs in Western and Eastern Africa, focusing on institution building to address energy efficiency and environmental issues, with linkages to the preeminent African-American universities.

6. Conduct a feasibility study of natural gas and LNG to meet the needs of LDCs and assist in carrying out a natural gas utilization study in one country as a means to reduce oil consumption and CO_2 output.

7. Design and implement a worldwide energy conservation outreach and technical information dissemination plan.

8. Design and implement a demand-side management program in Guatemala to achieve least-cost utility planning.

9. Assist the development of an A.I.D. Energy Strategy for the Latin America and Caribbean Bureau of USAID.

Private Sector Technology Transfer and Training

10. Conduct country-specific market assessments and development activities for promising U.S. energy efficient/environmental control technologies (ASEAN and Mexico).

11. Carry out surveys, conferences, workshops, study tours and exhibitions to promote exports of energy-efficient technologies and services by U.S. manufacturers and ESCO's.

12. Conduct energy efficient and environmental control technology transfer project in ASEAN region.

Energy Conservation and Demand Management in Power Systems

13. Provide assistance for the implementation of the Central America Power Efficiency Initiative, which will include power plant rehabilitation, line loss reduction, load management, and end-use efficiency improvements (Costa Rica, Guatemala).

14. Develop a Demand-Side Management handbook for developing countries and conduct a DSM conference to disseminate results worldwide.

15. Carry out preliminary electricity tariff studies designed to develop energy- efficient electricity pricing in cooperation with local utilities (India, Thailand).

16. Provide emergency technical assistance for the rehabilitation of the power sector in Panama, Nicaragua, and El Salvador.

17. Implement a load management and demand-side management program in Latin America or the Near East.

Energy Conservation and Demand Management in Industry

18. Conduct study of current status and future directions in cogeneration, including three case studies of private investment in cogeneration.

19. Implement an electricity demand management program in Indonesia.

Energy Conservation and Demand Management in the Building and Transportation Sectors

20. Update study of options for energy conservation in the transportation sectors of A.I.D.-assisted countries and identify countries for implementation of pilot projects and disseminate worldwide to developing countries and donor agencies.

21. Conduct a building energy standards conference for the ASEAN region and develop a model building energy code for the region.

Renewable Energy for Development

Renewable Energy Applications and Training Strategic Assessment and Policy Development

1. Support and participate in strategic energy sector assessments in key A.I.D. countries in order to define specific targets for renewable energy use and the policies and mechanisms required.

2. Jointly with UNIDO, sponsor an international conference to define the policy and programs that in turn would establish the market potential that will catalyze large-scale production of photovoltaics at reduced costs (India).

3. Work with other U.S. agencies, the U.S. private sector, and the MAGPI institutions to incorporate renewable energy options in MDB rural electrification and power sector lending (Indonesia, Mexico).

Renewable Energy Applications and Training Project Development Support and Technology Cooperation

4. Support, in collaboration with the U.S. Rockefeller Foundation, a U.S./Indian joint venture market seeding and financing program for photovoltaic (PV) power applications in rural areas as the basis for leveraging financing for a large-scale private sector PV module production facility in India.

5. Support expansion of a successful private sector PV-based rural residential power delivery project in the Dominican Republic, and foster replication in other countries.

6. Collaborate with U.S. wind energy industry, host country utility, and suitable international financing institutions in conducting preinvestment and prefeasibility analysis supporting project development for a windfarm in Costa Rica.

7. Assist US/ECRE in establishing IFREE and provide support for at least five pre-investment studies.

8. As a joint REAT/BEST activity, provide funds for Renewable Energy Project Support Offices in at least two countries, supporting at least seven pre-investment studies (Costa Rica and Indonesia).

9. Provide continued core funding for the Environmental Enterprises Assistance Fund, leading to at least three additional commercial investments.

Renewable Energy Applications and Training
Information Dissemination, Training, and Reverse Trade Missions

10. Provide support for the VITASAT program, including the establishment and operation of selected ground stations, in order to exchange information with remote locations.

11. Prepare two videos, and printed materials as requested or appropriate, that provide technical and economic information to LDCs, as well as to USAID Missions.

12. Support participation of LDC nationals in U.S. industry- and government- sponsored training programs and workshops, reverse trade missions, and industry symposia, and field A.I.D./U.S. renewable energy industry teams to explore joint venture opportunities.

Renewable Energy Applications and Training
Environmental Impact Assessment and Mitigation

13. Develop the unit on renewable energy in the Environmental Manual for Power Development, Phase II.

Biomass Energy Systems and Technology
Biomass Energy Project Development and Implementation

1. In two key countries, establish and/or maintain Renewable Energy Project Support Offices, and cost-share three or four preinvestment studies for biomass projects (Costa Rica and Indonesia).

2. Conduct an assessment of prospective electric cogeneration at sugar mills, establishing a framework for independent power generation nationwide, in two key countries (with co-funding from at least one USAID Mission) (India and Honduras).

3. Cost-share at least one case study of conversion of wood wastes to electricity (Honduras).

4. Identify two to four additional biomass power development opportunities in key countries for implementation in this or the next fiscal year (e.g., Philippines).

Biomass Energy Systems and Technology
Technology Adaptation and Transfer

5. Co-fund the adaptation of advanced conversion technologies, focusing on systems for biomass gasification, and the harvesting and handling of sugar cane field trash.

6. Publish two Bioenergy System Reports (one on wood energy in the context of sustainable forest management context, and a second on intensive silvaculture energy plantations) and proceedings from 1991 conference on energy from sugar cane.

7. Conduct an international conference on the role of biomass energy in rural development and forest resource management.

8. Effect a transfer of expertise in electric distribution system implications of decentralized renewable electric generation between the Pacific Gas and Electric Company and the regional power company serving northeastern Brazil.

Biomass Energy Systems and Technology
Biomass Energy Program Support

9. Assist with the selection and case studies developed in conjunction with the Biomass Users Network.

10. Expand private sector biomass energy opportunities through entrepreneurial networking and promote U.S. private sector opportunities/involvement through exchanges of information.

11. Maintain databases; complete refinement of CANEPRO, a computerized analytical tool developed by Winrock for evaluating sugar mill cogeneration investments.

Private Sector Participation in the Electric Power Sector

Assist in Defining and Implementing Private Enterprise Involvement

1. Conduct country assessments to determine the particular legal, regulatory, economic, financial, institutional, technical and political conditions that will impact on private enterprise involvement in the electric power sector (Guatemala, Brazil, India, and republics of the Commonwealth of Independent States).

2. Organize and conduct conferences or workshops on private electric power in Asia, the Middle East, Africa, and Latin America and the Caribbean (India, Thailand, Philippines, Egypt, Kenya, Venezuela, Nicaragua, Honduras).

3. Provide technical assistance to facilitate the development of private electric power (Indonesia, Mongolia, the Philippines, Guatemala, Dominican Republic, Jamaica, and republics of the Commonwealth of Independent States).

4. Conduct study tours in the U.S. and third countries for energy and finance officials from countries in Latin America/Caribbean, Asia, Africa the Middle East, and republics of the Commonwealth of Independent States.

5. Develop and conduct, in cooperation with the Energy Training Program, a training and internship program for senior and mid-level management from developing countries in Latin America/Caribbean, Asia, Africa and the Middle East, and republics of the Commonwealth of Independent States.

Provide Resources to Foster Private Electric Power Project Development Efforts

6. Promote and administer the PSED Feasibility Study Fund to attract qualified applicants with a high degree of probability for project implementation.

7. Organize and conduct workshops directed to electric power developers, investors, and financiers on practical aspects of project development and privatization in developing countries.

Information Gathering and Dissemination

8. Keep the Private Power Database up-to-date on the latest issues and activities related to private electric power.

9. Develop a monthly information package informing A.I.D. Missions and Bureaus of the private electric power activities of the Office.

10. Edit and publish the Private Power Reporter, as well as expand its circulation.

11. Develop a "Bulletin Board" feature for the PPR where project developers, investors, financiers, suppliers and other key players may identify each others needs and capabilities, and foment the formation of projects and project groups.

Energy Technology Innovation

Innovative Clean Energy Technology Applications

1. Conduct ASEAN Clean Coal Technology trade mission (jointly with PSED)

2. Clean Coal Technology (CCT) prefeasibility assessment in ASEAN

3. Technical support to India IGCC demonstration (jointly with PSED)

4. Conduct oil shale electricity workshop; initiate Egypt, Israel, and U.S. cooperative project

5. Organize and participate in AFSA infrastructure trade symposium (jointly with PSED)

Environment Enhancement Technology Applications

6. Conduct natural gas utilization definitional mission and workshop in key global warming country

7. Plan and implement an atmospheric emissions monitoring systems initiative and associated multilateral financing fund. Assess technology options for global warming emissions reductions (key countries).

8. Assess the costs and benefits of solid waste-to-energy applications (Thailand)

9. Develop (with BEST project) rice hulls power plant project (Egypt)

10. Environmental opportunities definitional mission

11. Geothermal opportunities assessment

Energy Efficiency and Availability Improvement

12. Conduct Phase 1 of power plant availability improvement project in Philippines (jointly with PSED).

13. Power plant diagnostics project development in India.

Energy Management and Operations Improvement

14. Scope energy resources management information system in Philippines (buy-in project).

15. Capital infrastructure program support project for the Philippines; manage and perform.

16. Perform a power plant operation and management needs assessment in an Asian country to be determined in collaboration with the U.S.-Asia Environmental Partnership (AEP).

Energy Training

Courses will be conducted in:

Energy Policy, Planning, Analysis, and Financing
National Energy Policy and Planning

Management of Energy Enterprises
General Management of Electric Utilities

Fossil Fuel Utilization
Low Rank Coal Utilization

Electric Utility Operations and Development
Electric-Utility Engineering

Global Warming Initiatives
Ambient Air Pollution Monitoring
Air Pollution Control Technologies

Appendix 2
Project Summary
Office of Energy and Infrastructure

		Funding			
Project Name/Number	Life of Project	FY 1992 ($ million)	Projected FY 1993 ($ million)	Project Officer	Chapter Reference
Energy Policy Development and Conservation (EPDAC) Project No: 936-5728	FY 1982 - FY 1993	2.419	0		
- Energy Planning and Policy Development (EPPD)		1.306	-	David Jhirad	2
- Energy Conservation Services Project (ECSP)		1.111	-	Alberto Sabadell	3
Global Energy and Environmental Management (GLEEM) Project No: 936-5744	FY 1993 - FY 2001	0	2.000	David Jhirad	2
Energy Efficiency Project (EEP)* Project No: 936-5743	FY 1992 - FY 2000	3.110	2.200	David Jhirad	3
Renewable Energy Applications and Training (REAT) Project No: 936-5730	FY 1985 - FY 1995	3.310	2.000	Ross Pumfrey	4
Biomass Energy Systems and Technology (BEST) Project No: 536-5737	FY 1989 - FY 1996	1.845	2.000	Ross Pumfrey	4
Private Sector Energy Development (PSED) Project No: 936-5738	FY 1989 - FY 1999	2.183	2.400	Samuel Schweitzer	5
Energy Technology Innovation Project (ETIP) Project No: 936-5741	FY 1990 - FY 1999	3.790	2.000	Samuel Schweitzer	6
Energy Training Project (ETP) Project No: 936-5734	FY 1987 - FY 1997	3.345	2.400	Shirley Toth or Samuel Schweitzer	7
Total Funding		20.000	15.000		

* These are planned successor projects to the two sub-projects of EPDAC.

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* *Not yet available in final report form*

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